ANALYSING CAUSES AND EFFECTS OF DELAYIN LEGEDADI DEEP WELLS WATER SUPPLY DESIGN ANDCONSTRUCTION PROJECT (I)

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Declaration

I hereby declare that the this thesis entitled **"Analyzing Causes and Effects of Delay in Legedadi Deep Wells Water Supply Design and Construction Project (Phase-I)"** was composed by myself, with the guidance of my advisor, that the work contained herein is my own except where explicitly stated otherwise in the text. And that this work has not been submitted, in whole or in part, for any other degree or processional qualification. Parts of this work have been published in (state previous publications).

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This is to Certify that the thesis prepared by **Student Zelalem Tsegaye Asmare** entitled **"Analysing Causes and Effects of Delay in Legedadi Deep Wells Water Supply Design and Construction Project (Phase-I)"** and submitted in fulfillment of the requirements for the degree of Master of Business Administration in Construction Management complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

This time the Ethiopia government gives its attention in the provision of infrastructure as it is the basic for the development of one country. In reflection of this consent Design and Construction of new Water supply Projects are widely seen. So many private (domestic and foreign) and governmental organization are participating on the sector in the study, design, construction and supervision field.There is an increase in the number of construction projects experiencing extensive delays leading to exceeding the initial time and cost budget.

The main objective of this research were to assess Causes and Effects of delay on **'Legedadi Deep Wells Water Supply Design and Construction Project (Phase-I).** As per the original signed contract agreement, the project is supposed to be completed in 12 months with the total allocated budget of ETB ***1.35*** Billion while due to time overrun the project have been completed in 15 months and consumed at the end of the project ETB 1.41 Billion which is higher by ETB 0.06 Billion or 4.44% than the contract amount which creates challenges to allocate additional budget on the client side, inefficient service delivery on the project owner, Addis Ababa Water and Sewerage Authority.

The study adopts quantitative and qualitative methods with the help of primaryand secondary data. Primary data was collected using self-administered questionnaires on 54 respondents and key informant interviews with 15well experienced in such specific water supply construction projects selected from the project owner, consultant, contractor and subcontractors. Secondary data was collected through reviewing of project documents.Such as; BOQ, Contract agreement, design documents, formal communication letters, and change orders etc.

Respondents were asked to rank the importance general and specific factors of delay causes using five points scale (1=Very low, 2= Low, 3= Average, 4= High and 5= Very High)and the analysis shows that, top causes of project delay were related to the Client, Consultant, Contractor and sub-contractors.

Major findings of this research are:

- ✓ The construction work was started based on design prepared on inaccurate inputs and assumptions, insufficient field investigation due to unrealistic three months deign period.
- ✓ ETB 60,000,000 additional cost (Variation) incurred and the Employers plan to collect ETB 20,007,000 from water selling in three month time has not been achieved.
- ✓ Due to incorrect Engineering cost estimation excess Pipes and materials purchased from abroad and ETB 81,846,397.81 Employers capital is unnecessarily tied up because total design length has been 107.52km and after project completion the actual total installed length becomes 89.48km which is less by 18.05km.
- ✓ Promise has been announced repeatedly to the public through mass media about the delivery day of potable water to the residents of condominium houses in the expansion area. However, the project has been completed and put into service after Three month delay and this creates public grievance due to low performance of the project owner.

The study suggested that current project planning, monitoring and evaluation system, starting from study/design stage up to commissioning date have to be improved by adopting the right tools and tested procedures, assigning the appropriate staffs from both

the project owner and the consultant, establish accountability and by applying timely knowledge based decisions so that, causes and effects of delay can be managed.

At large, research needs to continue in order to refine and find more effective mechanism to minimize if not avoid, causes and effects of project delays which are currently a chronic challenge of our country, Ethiopia.

Key Words: Causes, Effects and Delays, Design and Construction Project.

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List of Abbreviations

FGDRE	Federal Government of Democratic Republic of Ethiopia
AASTU	Addis Ababa Science and Technology University
AAWSA	Addis Ababa Water and Sewerage Authority
WEDSWS	Water and Energy Design and Study Works Sector
CGCOC	China group Construction Company
LDWWSP	*Legedadi* Deep Wells Water Supply Project
AA	Addis Ababa
ETB	Ethiopian Birr
VAT	Value Added Tax
DBB	Design, Bid and Build
GC	General Contractor
BC	Building Contractor
EM	Electrical Mechanical
Qty	Quantity
CD	Completion Date
PM	Project Manager
RE	Resident Engineer
MPWH	Ministry of Public Works and Housing (Jordan)
RII	Relative importance index
HCB	Hollow Concrete Block

CHAPTER 1

1. INTRODUCTION

The city of Addis Ababa is one of the cities in a rapid development course in all aspects in Africa. The city is the seat of central Government of Federal Democratic Republic of Ethiopia and Africa Union Head Quarters and different diplomatic missions are reside in the city and now a day's Addis Ababa is considered as a capital city of Africa. On the other hand the population growth of the city is high and different huge investments including Housing projects are undergoing. due to this, existing water supply scarcity becomes increasing from time to time and the need of developing new additional potable water sources becomes among prioritized tasks of the city Administration of Addis Ababa and central Government.

Due to this, Study, Design and Construction of different new water supply projects have been made and one of the Project Constructed in this program has been **LDWWSP, '*Legedadi* Deep Wells Water Supply Design and Construction Project (Phase I)** to supply North East part of the city specifically expansion areas.

LDWWSP is one of the water supply projects implemented to alleviate the prevailing unsatisfactory water supply situation at the capital city, which is an important service for one of the most water deficit areas in Bole and *Yeka* sub cities.

Source of water, 10 deep wells are located in *Legedadi* well field with a maximum discharge or production of 54,000m^3/day. The conveyance system starts from *Legedadi* to Ayat square through *Legetafo, Yeka Abado* and *Yeka Ayat*. And it distribute to *Yeka*

Abado, Yeka Ayat, Bole Summit, Bole *Ayat* and Bole *Arabsa* condominium sites as well as the nearby existing residents.

The project at the beginning has been designed to produce 40,000m^3/d which has a total capacity of satisfying a daily demand of 333,333 inhabitants at a daily consumption rate of 120 l/c/head and the surplus water after supplying condominium houses was planned to distribute to existing system to alleviate water shortage of nearby areas and reinforce the central part of the city. While designing the water supply system, the necessary complete data of all ten wells drilling results was not obtained, discharge of 7 wells and some other design imputes were assumed. Due to this, after drilling completion of the remaining 7 wells the total production increased to 54,000m^3/d which can satisfy 450,000 inhabitants per day at 120l/c/d consumption rate.

Incorrect assumption inputs and may be design errors during the design process may be caused;

- Big difference in total supply and installed length of water pipes.
- Affects project construction time table due to design revision.
- Design review and change of Electromechanical equipment's
- Late service delivery and
- Affects revenue collection plan of the client.

As per the original plan or signed contract agreement; Study, design and construction of the project is supposed to be completed in 15 months (3+12) with the allocated budget while due to time overrun the project have been completed in 18 months (One year and 6

months) which causes inefficient service delivery on the project owner, Addis Ababa Water and Sewerage Authority.

This thesis will examine causes and Impacts of delay in an integrated manner and determines how critical delay causes are most influential in project performance. This will provide owners, Consultants and construction organizations involved in construction projects with the foundation on which such strategies on how to avoid delays can be developed in the future

1.1 Problem Statement

Delays in a Study and Design or construction projects is counted as a common problem worldwide and became a cause for projects completion with huge cost overrun (requiring higher budget than estimated), extended completion time, inferior quality deliverables and contract termination. In recent time it was an acceptedphenomena to have delays in construction projects completion time.

For the client, construction delay is a:

- ✓ Loss of revenue,
- ✓ Lack of productivity,
- ✓ Dependency on existing facilities,
- ✓ Creates public grievance etc.

For the contractor, construction delay is:

- ✓ The higher costs,
- ✓ Longer work duration,

- ✓ Increased labor cost,
- ✓ Higher material and equipment costs etc. Completion of construction projects on

Specified time or time agreed by the parties indicates their efficiency. The delays in construction projects happen because of various factors or causes. These causes lead to the delay in construction completion, and this delay ultimately leads to negative effects on the construction project.

In Ethiopian construction practice, it is very rare that construction projects are completed on the time specified or agreed upon. There are many infrastructure design and construction projects in Addis Ababa, which suffered delay or in some cases suffered suspension or abandonment.

1.2 Research Questions

The following were the research questions of this study:

1. To what level does the project owner participated in evaluating and commenting On Draft and Final design reports submitted by the Consultant?
2. What are the major problems faced by the consultant during study and design Process of the project?
3. What are the major problems associated with the project design documents?
4. What are the major causes and Impact of delay on the project?
5. How much revenue lost by the owner of the project due to delay?

1.3 Research Objective

1.3.1 General objectives

The general objective of this study is to assess the major causes and Impacts of delays on '*Legedadi* Deep Wells Water Supply Design and Construction Project (Phase I) on the successful completion of the project.

The primary objective is to identify the principal Causes or factors responsible for delays and their effect on the progress; as well as timely delivery.

1.3.2 Specific Objectives

1. To explore construction project delays related to project study and design document Preparation works.
2. To identify Causes and Impacts of delay factors that currently exist water supply Design and construction projects by exposing the most common and fundamental Problems affecting project delivery performance.
3. To briefly survey major potential Causes and Impacts of delays from different Stakeholder's perspective.
4. To identify the success factors which are most influential in avoiding or preventing Delay factors.

1.4 Scope of the Study

The scope of this research is limited to the study, design and construction of *Legedadi* Deep Wells Water Supply Project in Addis Ababa. The data for this study will be gathered through:

- Detail Project Design, Bill of Quantities, Reports, Financial documents, contract agreement, Specifications etc.
- Detailed literature review,
- Questionnaire survey,
- Interview with key professionals and case studies.

1.5 Research Methodology

Research method will be formulated to address the research questions and meet the objectives through theories based on contextual realities of the study area.

The methodology adopted for this research comprises the following three stages:

Stage 1.

Literature Review to determine the research focus. Local and International studies conducted particularly on related works and construction delays in general were reviewed.

Stage 2. Data collection, Questionnaire Survey, this stage consists of two activities

Activity 1.

General survey of stakeholders (Owners, Contractors, Consultants And Subcontractors) to examine the cause and Impacts of design and construction delays in *Legedadi* Deep wells water supply design and construction project (phase I).

Activity 2.

Specific survey of stakeholders and **participant professionals** in the Design and construction of LDWWS Project (Owners, Contractors, Consultants and Subcontractors) to identify the Causes of delay and Their Impacts on the final result of the project.

Stage 3.

Data analysis using scientific methods from raw data collection followed by sorting the data and under-takes analysis on specific issues related to the study topic causes and impacts of delay in the case of *Legedadi* Deep Wells Water supply Project (Phase I) constructed for the city of Addis Ababa in Ethiopia.

Additional to the above activities, the following project documents will be reviewed;

- Detail Project Design Reports,
- Bill of Quantities,
- Contract agreement,
- Specifications etc.
- Interview with key professionals and Experts and
- Payment certificates and foreign procurement documents

1.6 Outline of the Research

This thesis format follows the logical steps of establishing the research questions, developing the methodology, gathering and analyzing data, and drawing conclusions. The Thesis is organized into **Sixchapters** as follows:

Chapter 1;

Discusses the introduction of the research by highlighting the research problems, research purpose, research objectives, proposed methodology and research organization.

Chapter 2;

Presents a literature review in-depth understanding of definitions. It examines Literatures, studies and journals about delay factors in the study design and construction projects. Effects of construction delays on project delivery performance and prime measures of success i.e. time, cost and quality. The literature and studies on classification and causes of delays at different stages of project life cycle and allocation of responsibilities among parties in contract.

Chapter 3;

Describes the data collection method, analysis techniques and statistics used

To identify causes of delay on '*Legedadi* Deep wells water supply design and construction project (Phase I)'. It also explains the analysis used to determine the correlation between critical delay causes and its effect on project delivery performance measures.

Chapter 4;

Presents the findings and discussion based on the results obtained from questionnaire responses.

Chapter 5;

Presents the case study selected from different completed water supply design and construction projects in Addis Ababa.

Chapter 6;

Is the conclusion and recommendation chapter and discusses the research conclusions, limitations of the research, contribution to new knowledge, and provides recommendations based on this research findings.

1.7 Definition of Basic terms

Project Cost; is the budgeted expenditure, which the client has agreed to commit for acquiring the desired construction facility. These cost elements include labor costs, material costs, plant and machinery costs, administration costs and other expenses. In order to identify costs associated with an activity, construction costs are categorized into „Direct costs" and „Indirect costs" or „Overhead costs".

Construction delay; can be defined as the late completion of work compared to the planned schedule or contract schedule. Could be defined as the time over run either beyond completion date specified in a contract or beyond the date that the parties agree upon for delivery of a project. It is a project slipping over its planned schedule and is considered as a common problem.

It can be defined as the distinction between the real finish date and the estimated date and also it is defined as the period during which the project or part of it has been extended or not completed due to unexpected conditions.

Disruptions; Disruptions are events that disturb the construction programme, Interferences with the flow of work in the project are common disruptions. Many disruptions to complex projects are planned for at the bid stage because they may be expected to unfold during the project. For example, some level of rework is usually expected, even when everything goes well, because there will always be 'normal' errors and mistakes made by both the contractor and client.

Actual costs; are defined as the accounted costs actually spent, as determined at the time of project completion.

Estimated costs;are defined as the budgeted or forecasted costs at the time of project approval, which are typically similar to costs presented in the business case for a project.

Cost overrun; Is defined as the difference between the actual and estimated costs as a percentage of the estimated cost, with all costs calculated in constant prices. It involves unexpected excess cost occurred due to underestimation of the expected budget of the infrastructure projects.

Claims; If the Contractor suffers delay and/or incurs Cost from executing work which was necessitated by an error in these items of reference (emphasis by the writer: Setting out/ site hand over), and an experienced contractor could not reasonably have discovered such error and avoided this delay and/or Cost, the Contractor shall give notice to the

Engineer and shall be entitled subject to an extension of time for any such delay, if completion is or will be delayed, Extension of Time

Design Defects; The failure of the design professionals to produce complete, accurate and well-coordinated design results in defects which may be grouped under design error, omission or a combination of both.

Design Responsibility;Construction managers, retained to manage the construction, often assume some of the design Responsibility, along with the risk of construction cost-overruns and delays resulting from design errors. General contractors, subcontractors and suppliers are also increasingly assuming design responsibility. Contractors and suppliers frequently submit design elements for the approval by the design team.

Design Defects;The failure of the design professionals to produce complete, accurate and well-coordinated design results in defects which may be grouped under design error, omission or a combination of both are of the view that design and maintenance are actually two crucial criteria in the building process on which the life cycle of buildings depends.

Construction Defects;Are deficiencies in design, construction and /or in the materials or systems used in a project that may not be readily observable and result in a building, structure or components that are not suitable for the purpose intended. Construction defects arise as a result of many factors which could be visible to the naked eye or concealed deep within the structure. Construction defects which directly affect the performance of a structure can be a result of defective design or construction. In general,

construction defects comprise of defects such as a design that fails to meet the professional standard, a decision that is not in accordance with codes, among others.

Disputes;Are the effects of major causes of delays in construction projects such as causes of Client related, Contractor related, Consultant related and external related that may be arisen during the construction projects among the project parties

CHAPTER 2

2. LITERATURE REVIEW

2.1 General

A „construction project" is a high value, time bound, special construction mission of creating a construction facility or service, with predetermined performance objectives defined in terms of quality specification, completion time, budgeted cost and other specified constraints (Chitkara, 2011).Time and Cost are amongthe five main parameters that can sufficiently define a construction project. Other parameters are scope, quality and resources. The five parameters are interactive, that is, each parameter is a function of other. The evaluation and balancing of interrelationship among the five project parameters is a complicated process. However, in a given project, the scope and quality of work in terms of quantity and specifications are specified and these parameters are not subjected to change (unless scope changes substantially). Resources and costs are co-related. Therefore, for a given quality, in such situation, time, cost and scope are core parameters. These parameters are interlinked and must be kept in balance to achieve project objective efficiently and effectively within changing environments (Chitkara, 2011).

The development of Time and cost estimates that accurately reflect project scope, economic conditions, and are attuned to community interest and the macroeconomic conditions provide a baseline cost that management can use to impart discipline into the design process. Projects can be delivered on budget and Time table but that requires a good starting estimate, project management discipline and an awareness of factors that

can cause delay and cost escalation (Shane et al., 2009). Construction time serves as a benchmark for assessing the performance of any project. Due to unexpected problems encountered during Conception, designing & construction phase often led to unwanted delay in project completion.

The construction project consists of three phases namely: Conception/designing, bid and Construction/build (DBB). Timely completion of projects is an indicator of efficient construction industry. Construction time often serves as a benchmark for assessing the performance of a project and the efficiency of the project organization. A project is said to be successful on timely completion. The time required to complete construction of projects is often more than specified time in Contract. These ‘overruns‘ or, time extensions happens due to many reasons, such as designer changes or errors, economic conditions, resource availability and performance of project parties.

Usually, majority of project delay occurs during Construction phase, where unforeseen factors (environmental concerns and restrictions, ground conditions etc.) are always involved. Construction delays lead to increase in overall project cost, henceforth completing projects on time is beneficial to all parties involved in projects. Therefore, it is essential to identify the actual causes of delay in order to minimize and avoid the delays and their corresponding expenses.

A timely completed project is usually regarded as ‘successful’ within budget and to the level of quality standard as specified by the client at the outset of the project. In fact, the realization of the present complex construction projects involves the co-operation and co-ordination of various parties including the clients, consultants, contractors, subcontractors, and suppliers (Cherns and Bryant, 1984). However, the way in which the

client organizes and manages the project will also exert a significant influence on subsequent project outcomes.

According to Chitkara (2011), the main controllable causes of the projects‟ Delay and cost overruns include but are not limited to the following:

- ✓ Inadequate project formulation: Poor field investigation, inadequate project information, bad cost estimates, lack of experience, inadequate project formulation and feasibility analysis, poor project appraisal leading to incorrect investment decisions.
- ✓ Poor planning for implementation: Inadequate time plan, inadequate resource plan, inadequate equipment supply plan, inter-linking not anticipated, poor organization poor cost planning.
- ✓ Lack of proper contract planning and management: Improper pre-contract actions, poor post-award contract management.
- ✓ Lack of project management during execution: Insufficient and ineffective working, delays, changes in scope of work and location, law and order.

2.2 Definition of Delay

Definition of delay stated by various scholars in different ways. Delays are defined as vents or occurrences that affect the time required to complete a particular task. Assaf and Al-Hejji (2006) defined construction delay as the time over run either beyond completion date specified in a contract or beyond the date that parties agree upon for delivery of a project . It is slipping over its planned schedule and is considered as common problem in construction projects. Delay was also defined as an “act event which extends required

time to perform or complete works of the contract manifests itself as additional days of work" by Zack (2003).

2.3 Classification of Delays

The type of delay has an impact on critical activities which need a more detailed analysis to determine whether additional time extension is warranted or not. Excusable delays can be further classified into excusable with compensation and excusable without compensation. Terry Williams (2003) revealed that there are four basic ways to classify delays: Excusable or non-excusable delay, Concurrent or non-concurrent delay, and Compensable or non-compensable delay.

- **A non-excusable delay** is delay caused by the contractor or its suppliers, through no fault by the owner. The contractor is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. Therefore, non-excusable delays usually result in no additional money and no additional time being granted to the contractor.

  These are some examples of non-excusable delays (Al- Gahtani and Mohan 2007):

  - ✓ Late performance of contractor and/or sub-contractors
  - ✓ Untimely performance by suppliers
  - ✓ Faulty workmanship by the contractor or sub-contractors
  - ✓ A project-specific labor strike caused by either the contractor's unwillingness to meet with labor representative or by unfair labor practices

- **Excusable delays** are divided into two: **compensable and non-compensable** delays.

  Compensable delays are caused by the owner or the owner's agents (Consultant).A compensable delay is a delay where the contractor is entitled to a time extension and to additional financial compensation.

  While non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. These delays are commonly called “acts of God” because they are not the responsibility or fault of any particular party. (Wa’el Alaghbari (2007); Saleh Al HadiTumi (2009).

  At large, Delays resulting from the following events would be considered as excusable:

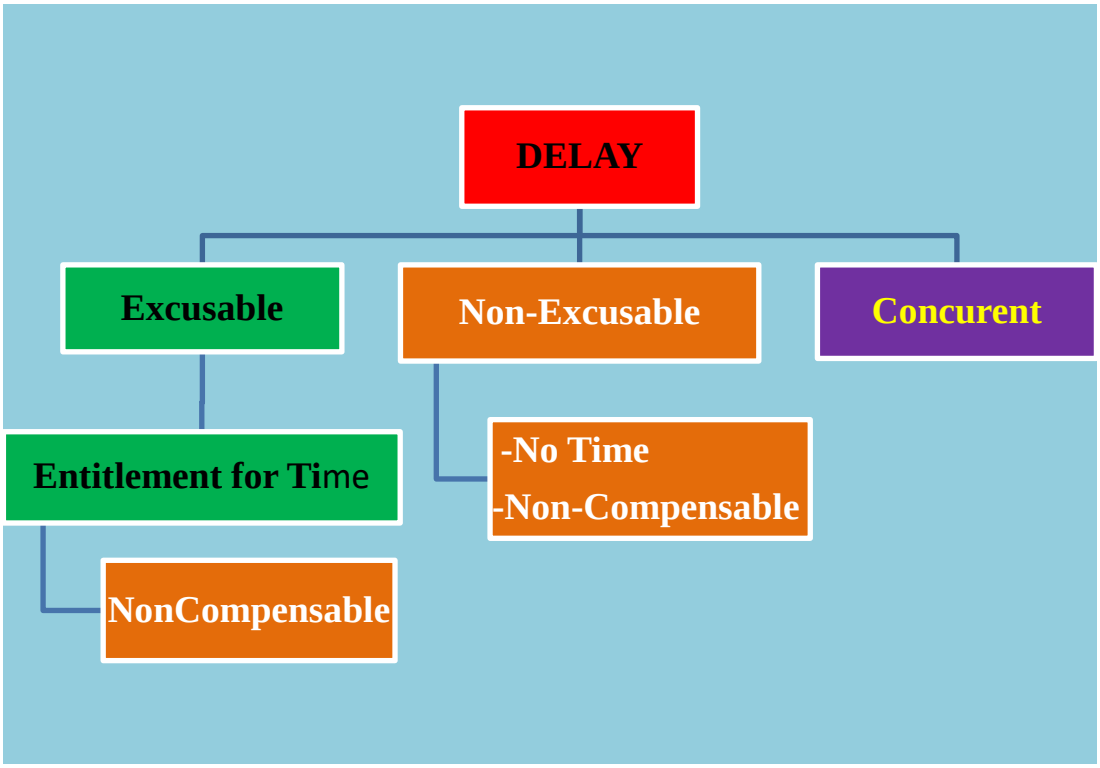
  - ✓ General labor strikes
  - ✓ Natural disasters or act of God (Fire, Earth quickand Floods).
  - ✓ Instruction of Owner’s for additional works
  - ✓ Differing site conditions (Soil and terrain condition)
  - ✓ Late Commencement date (site handing over to the contractor).
  - ✓ Delayed in payment (advance or progressive).
  - ✓ Unusually severe weather
  - ✓ Intervention by outside agencies

- The Third type of delay factor is called **Concurrent delay**. A more complicated one and this is very typical in construction project. This situation happened when more than one factor delays the project at the same time or in overlapping periods of moment.

- ✓ When the non-excusable delay is on the critical path and the excusable delay is noncritical, no extension of time is due.
- ✓ When the non-excusable delay is non-critical and the excusable delay is on the critical path, extension of time is due even if the non-excusable delay commenced early in the non-critical chain of activities in so far as the non-excusable delay does not impact the critical activity.
- ✓ When both excusable and non-excusable delays are critical and commenced together and cease at the same time, both the employer and Contractor should bear responsibility for them. The Contractor is entitled to extension and is not entitled to associate costs even if the excusable delay is a compensable delay.
- ✓ When an excusable delay occurs first on a critical path followed by a non-excusable delay on a parallel critical path, the dominant cause of delay should be the deciding factor.

For example, if two delays are concurrent, and one is five days long and the second is seven days long, the second concurrent delay will only extend the contract completion time by two days.

Figure: 2.1- Classification of Delays (Saleh Al HadiTumi 2009 and Harry *Kent, 1995)*



The types of delays mentioned above are originated from internal or external sources on project process. Internal causes of delay include causes that come from the owner, designers, contractors, and consultants. External causes of delays are originated from outside of construction projects such as utility companies, government, subcontractors, suppliers, labor unions, nature, etc.

2.4 Causes of Delays

Construction delay is considered to be one of the most recurring problems in the construction industry and it has an adverse effect on project success in terms of cost, time, quality, and safety. There are several factors that cause delay in construction. Delay may be caused by Clients or Owners, Consultants and Designers, Contractors, Sub-contractors and Suppliers.

In a study of the significant factors that cause delay of construction projects (Alaghbari, Kadir,Salim and Ernawati, 2007), classified the factors into four major groups stated as follows;

- ✓ Contractor factor,
- ✓ Consultant/Designer factor,
- ✓ Client factors and
- ✓ External factors.

Financial problems, shortage of materials and poor site management practices were considered the top most factors. Client related factors included delayed payments, slow decision-making, frequent change orders, bid award for lowest price and contract scope changes. The most important factors by consultant were provision of incomplete design, poor supervision, slowness to give instructions and lack of experience. External causes identified included shortage of materials availability, poor site conditions and lack of equipment and tools in the market. In a related study of the causes and effects of delay in Malaysia construction industry Sambasivan & Soon (2007) found poor site management, inadequate experience' and poor subcontractors among the major causes of time delays on construction projects.

Projects can be delayed for a large number of reasons and usually impact on cost and time. Battaineh et al. **(2002)** studied causes of construction delay in Jordan. Results of the survey indicated Contractors and Consultants agreed that Owner interference, inadequate Contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and Sub-contractors are among the top ten significant factors.

Mansfield et al **(1994)** studied the causes of delay and cost overrun in construction projects inNigeria. The results showed that the most important factors are financing and payments, poor contract management, changes in site conditions, shortage of material, and improper planning. Similarly, Aibinu et al **(2002)** made a research on effects of construction delays in Nigeria. The findings showed that time and cost overruns were frequent effects of delay. Delay had significant effect on completion cost and time of 61 building projects studied. Client-related delay insignificantin Nigeria.

2.5 Frequency of Delayed Projects

The importance of construction projects, frequency of delayed projects and direct and indirect costs associated with such delays have inspired many researchers. The literature is rich with studies that have identified different delay factors and the risks associated with them. Of course, the business environment is dynamic and the causes of delay in construction projects are constantly evolving. Consequently, studies may present dissimilar delay factors through time. Furthermore, the role and profile of any participants who respond to surveys have an effect on the results and the importance of delay factors. For instance, owners tend to over-estimate the delays of the contractors and consultants, while under-estimating their own delays. Simply, lack of attention to the profile of the participants may make the results biased. For instance, while Odeh and Battaineh (2002) mentioned "contractor experience" as an important delay factor in Jordan, this factor is not an important delay factor in the same country according to Sweis et al. (2008). Another example is from Assaf and Al-Hejji (2006). In this study, factors such as "slow preparation" and "approval of shop drawings", "change orders", "human resources" and "poor workmanship" are among the most important delay factors in Saudi

Arabia; however, according to Al-Khalil and Al-Ghafly (1999), the mentioned factors are not important delay factors in that country.

According to Baldwin et al. (1971), the most important causes of delay in the United States are weather conditions, labor shortage and delays by sub-contractors. Delays in Turkey were first studied by Arditi, Akan and Gurdamar (1985) which concluded that in 1970s the main causes of delay in the publicly funded construction projects in Turkey were shortage of construction material, late payments and contractor defects. A second study about the causes of delay in construction projects in Turkey was conducted by Gündüz, Nielsen and Özdemir (2013) which identified 83 delay factors in nine major categories. The most important causes of delay in Turkey, according to Gündüz, Nielsen and Özdemir (2013), consisted of 15 factors including inadequate contractor experience, ineffective project planning, poor site management and change orders. In Hong Kong, the main causes of delay and cost overrun in construction projects were identified as poor site management, unforeseen ground conditions, poor decision making and change orders (Chan and Kumaraswamy, 1997; Chan and Kumaraswamy, 2002). Meanwhile, Indonesian construction projects experienced delays mainly due to change orders, low labor productivity, poor planning and shortage of material (Kaming et al., 1997). Le-Hoai, Dai Lee and Lee (2008) studied the causes of delay in several countries and compared them with the factors in Vietnam. Accordingly, loose deadlines, lack of experience, design inefficiencies, poor cost estimates, financial capabilities, government and labor incompetence were identified as the most important delay factors in Vietnam. In Thailand, on the other hand, the most important causes of delay in construction projects were described as resource and labor shortages, inefficient contractor

management, poor design, poor project planning, change orders and financial difficulties (Toor and Ogunlana, 2008).

Causes of delay in construction projects in Malaysia have been studied in several research papers. According to Abdul Kadir et al. (2005), the most important delay factors were shortage of material, late payments to suppliers, change orders, late submission of drawings and poor site management. Using a different questionnaire, Sambas van and Soon (2007) described 10 reasons including improper planning, poor site management, lack of experience, late payments, problems with subcontractors, labor supply and shortage of material as the most important delay factors in Malaysian construction projects. Alaghbari et al. (2007) list financial and coordination problems as the most important delay factors in Malaysia. Hamzah et al. (2012) list several factors including labor productivity, material delivery, inflation, insufficient equipment and slow decision making as delay factors in Malaysia. One can confirm that although different studies list a number of common items as the delay factors in Malaysian construction projects, having non-recurrent factors between different studies is normal. Differences in the determined factors can be traced back to a number of inconsistencies between the studies, including dissimilar survey methods, different number of respondents, differences between the profiles of the respondents, dissimilar statistical methods, etc. Table 1 lists several papers that have identified the reasons for construction project delays in developing countries in the Middle East, Asia and Africa. Based on our review of the literature, we can clearly conclude the following:

Although some similarities exist between different studies, we note that each study explores the construction delay issue according to the influential parameters and specific environmental factors in which the research is conducted. In other words, the delay factors and their importance may be different between countries with different social and economic environments. Local laws and regulations, which are obviously dissimilar between various countries, exhibit a significant effect on the delay factors. The effect of laws and regulations on the delay factors can be best noticed from studies such as Odeh and Battaineh (2002) and Sweis et al. (2008) for Jordan; another example is Assaf and Al-Hejji (2006) and Al-Khalil and Al-Ghafly (1999) for Saudi Arabia.

- The followings are a dearth of comprehensive studies to determine the reasons for delay in construction projects in Iran.

Table: 2.1- Studies on the Reasons for Delay in Construction Projects

Studies on the Reasons for Delay in Construction Projects Citation	Country	Major Causes of Delay
Abd El-Razek, Bassioni and Mobarak (2008)	Egypt	Financing problems Late payments
		Change orders/Design
		Inexperienced management
		Poor contractor management
		Material procurement
		Technical performances
		Inflation
Iyer, Chaphalkar and Joshi (2008)	India	Several factors, categorized as excusable and non-excusable
Doloi, Sawhney and Iyer (2012)	India	Client's interference
		Inefficient construction planning
Pourrostam and Ismail (2012)	Iran	Late payments
		Change order
		Poor management
		Inefficient decision making
		Ineffective planning
Al-Momani (2000)	Jordan	Change orders
		Slow decision making
		Weather and site conditions
		Late deliveries
		Economic conditions
Koushki, Al-Rashid and Kartam (2005)	Kuwait	Change orders
		Lack of experience
Aibinu and Jagboro (2002)	Nigeria	Client-related issues
Saleh, Abdelnaser and Abdul (2009)	Libya	Insufficient coordination

		Ineffective communication
Assaf and Al-Hejji (2006)	Saudi Arabia	Slow preparation and approval of shop drawings
		Late contractor payments
		Change orders
		Human resources
		Poor workmanship
Faridi and El-Sayegh (2006)	UAE	Slow preparation
		Lack of early planning
		Ineffective decision making
		Human resources
		Poor management

2.5.1 Project Delay studies in Malaysia.

Construction industries are a growing industry in Malaysia. Fundamentally, construction activities are derived from the local economic activities in Malaysia. Construction of non-residential and residential buildings contributed between 40 to 55 percent of the total construction market between 2006 and 2009.

KPKT (2010) define the project delay is the project who are experiencing delays in construction period where different gaps between the actual in progress sites work compared to the work scheduled which is between 10% to 30%. Meanwhile sick project is the project are experiencing delays in construction period where gap between actual work progresses compared to the work scheduled is more than 30% or the projects are failed to complete in the construction period.

Failure to achieve: targeted time, budgeted cost and specified quality result in various unexpected negative effects on the projects. Usually, when the projects are delayed, they are either extended or accelerated the time and therefore, invite to the additional cost. Although the contract parties agreed upon the extra time and cost associated with delay, in many cases there were problems between the owner and contractor as to whether the contractor was entitled to claim the extra cost. (Murali Sambasivan 2007).

A numbers of project delay cases are recorded. The first case is at main campus of University Malaysia Kelantan and second case of delay is a construction of research complex in National University of Malaysia, Bangi. Both cases are experienced delay. Delays give increase to disturbance of work and loss of productivity, late completion of project increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to reduce the possibility of delay occurrence or identify it at early stages.(Saleh Al Hadi Tumi 2009).

Sam basivan et al. **(2007)** identified six most frequently observed effects of delays in his survey on causes and effects of delays in Malaysian construction industry. These were:

1. Time over-run,
2. Cost overrun,
3. Disputes,
4. Arbitration,
5. Litigation, and
6. Project Termination

2.5.2 Project Delay Studies in Saudi Arabia

In Saudi Arabia, Assafet. al. (2006) conduced a research about construction project delay on different type of project in the state. It was concluded that **70%of projects experience time overrun.** The survey was conducted with 23 contractors, 19 consultant and 15 owners. Seventy-three cause of delay was recognized and the causes are grouped into nine classes. The outcome of the survey that agreed by all three parties is **change order**. The overall results are stated that the factor related to labor, contractor, project, owner

and consultant are in the highest rank. Consultants play a very important role in design-related delays because they are in charge of the design process in conjunction with the owner of the project. Furthermore delayed in payments categories do not have the same negative impact on project completion times as other factors considered in this study such as code, design and construction related issues.

Al-Ghfly (2005) identified that, project owner involvement, contractor performance and the early design and planning of projects are important factors for the project delay in Saudi Arabia. The study discussed delay in public water and sewage projects. Sixty causes were identified and classified. He concluded the following:

The delay occurred frequently in medium and large size projects, and considered severe in small projects. Important delay causes are related to owner involvement, contractor performance, and the early planning and design of the project. Important delay causes were found to be: financial problems, changes in the design and scope, delay in making decisions and approvals by owner, difficulties in obtaining work permit, and coordination and communication problems.

The study recommended to owners (Timely payment to contractor, minimum change in order during construction, timely reviewing and approving of design documents, checking resources and capability of contractor), contractors (sufficient number of labors, managing financial resources, proper planning and scheduling, better site management and supervision), and consultants (timely reviewing and approving design documents, flexibility in evaluating contractor works).

2.5.3 Project Delay Studies in Jordan.

130 public projects in Jordan have been investigated the causes of delay by Al-Momani (2000) in year 2000. The whole projects indicated that poor design and carelessness of the owner, change orders, weather condition, site condition, late delivery, economic conditions, and increase in quantities are the main causes of delay. The presence of these factors has an impact on the successful completion of projects.

A cost overrun is known as budget overrun or cost increase. It involves unexpected excess cost occurred due to underestimation of the expected budget of the infrastructure projects. Thus, it is important to study these cost overruns factors and to avoid them for maximum benefits and returns from infrastructure construction project.

Most infrastructure projects in Jordan are characterized by overrun in cost and time. Problem of cost overrun is critical and needs to be studied and alleviated. In the future recommendations should be developed to overcome these critical factors for future infrastructure projects. For this reason, final repots collected from the Ministry of Public Works and Housing (MPWH) in Jordan were analyzed and examined for several infrastructure projects in Jordan over the years 2000-2008. The actual causes for cost and time overrun recorded in the final reports of these projects were identified. Data were ranked based on their significance and the critical factors influencing cost and time overrun were identified.

Figure: 2.2- Planned and actual time for 14 sample projects in Jordan.

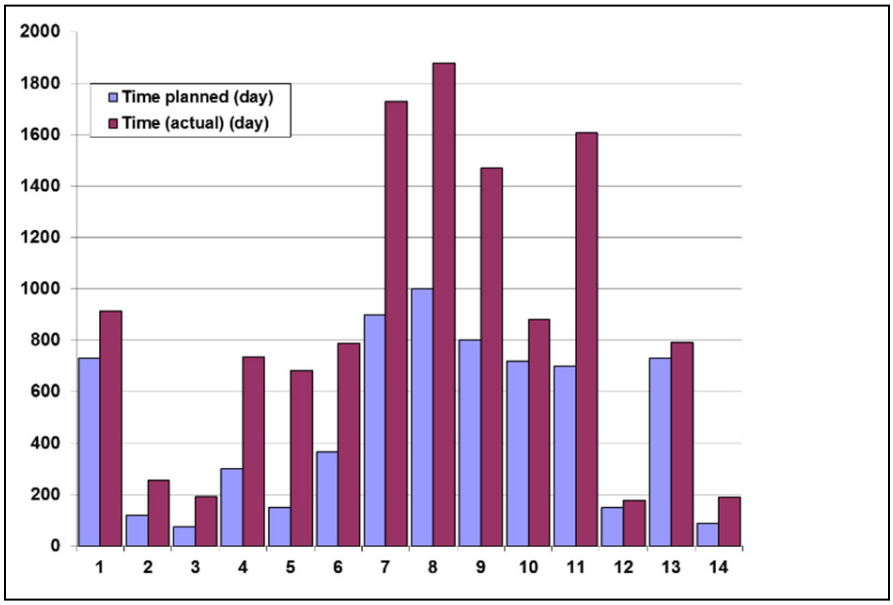


Figure: 2.3-Shows the planned and actual cost for 14 samples in Jordan

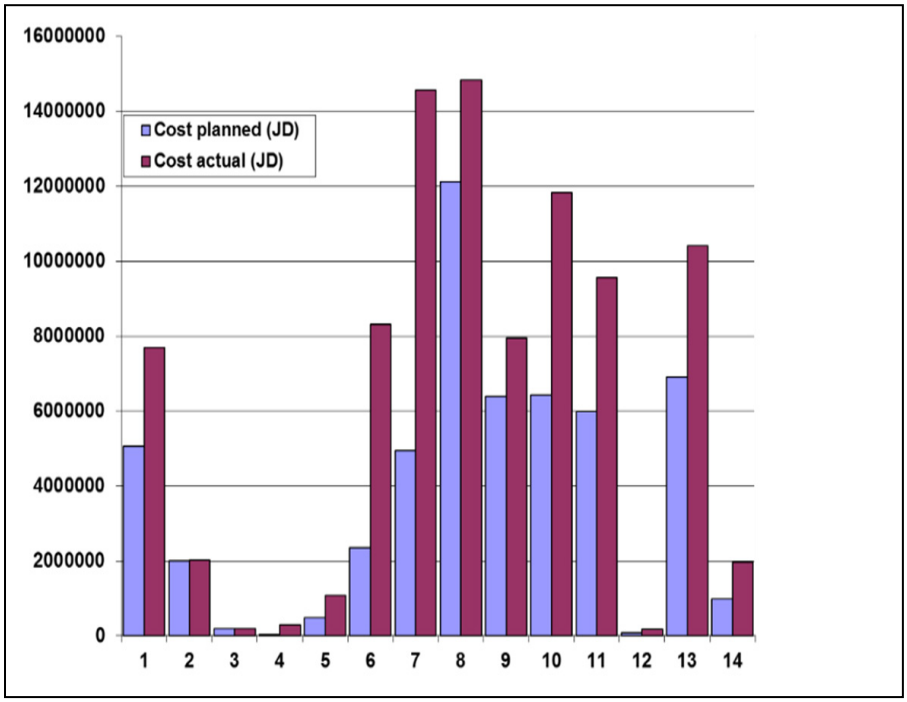
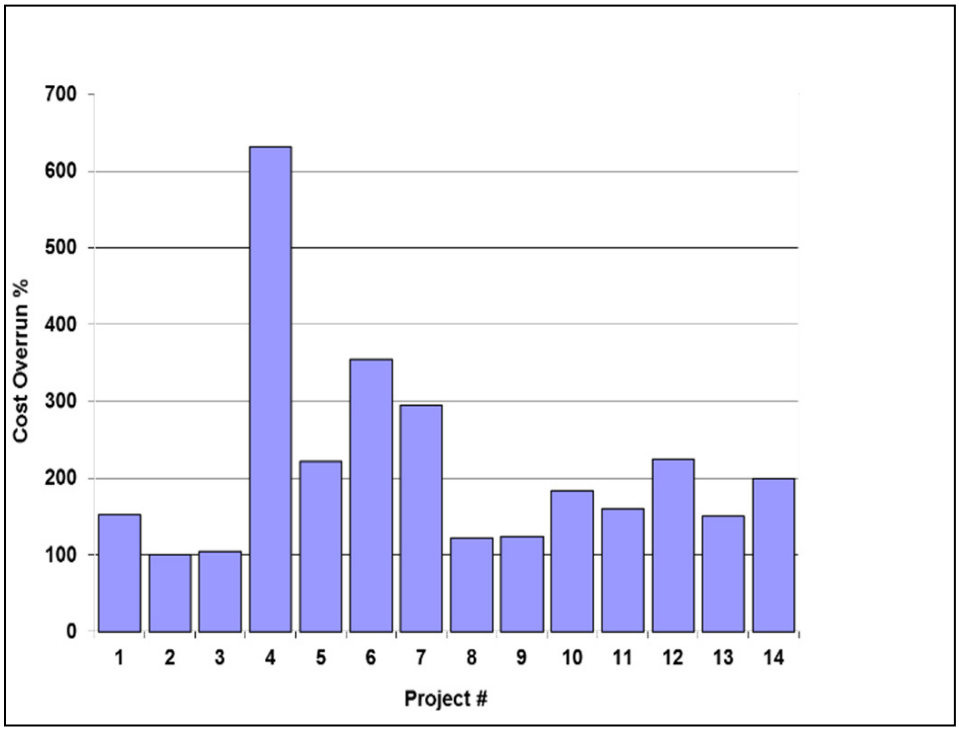


Figure: 2.4-Shows the cost overrun for 14 sample projects in Jordan.



2.5.4 Delay causes in Egyptian construction projects

Extensive study has been performed in Egypt by Mohamed M. Marzoukand Tarek I. El-Rasasin, (2012) on delay causes in Egypt construction projects.

And as the survey result shows, 33 experts responded. The experts were divided into three groups each group consists of eleven experts;

- ✓ The first group represents owners.
- ✓ The second represents consultants
- ✓ While the third represents contractors. All respondents hold senior positions with related working experience and the majority of them had practiced in the field for 20–30 years.

The final results of the research are described in the following table on the next page.

Table: 2.2-Delay causes of construction projects.

No	Delay group	Causes
1	Owner related	Slow decision making
		Suspension of work
		Late in revising and approving design documents by owner
		Delay to furnish and deliver the site to the contractor
		Delay in finance and payments of completed work by owner
		Variation orders/changes of scope by owner during construction
		Type of project bidding and award (negotiation, lowest bidder)
		Unrealistic contract duration
		Ineffective delay penalties
		Owner interference
2	Consultant related	Inadequate experience of consultant
		Delay in approving shop drawings and sample materials
		Mistakes and discrepancies in design documents
		Unclear and inadequate details in drawings
		Quality assurance/control
3	Contractor related	Difficulties in financing project by contractor
		Poor site management and supervision
		Ineffective planning and scheduling of project
		Rework due to errors during construction
		Delays in sub-contractors work
		Inadequate contractor experience
		Delay in site mobilization
		Delay in preparation of shop drawings and material samples

2.6 Effects of Delays

The desire to finish a project on time, under the planned budget, and with the highest quality is common goals for all contracting parties, including the Owner, Contractor and Consultant. Delay usually result in losses of one form or another for everyone.

Cost, time, and quality have proven their importance as the primary success factors of a project. According to Ahmed, et al delays on construction project are a universal

phenomenon. They are usually accompanied by cost overruns. Delay has a negative effect on clients, contractors, and consultants in terms of growth in adversarial relationships, mistrust, litigation, arbitration, and cash-flow problems. A project may be regarded as a successful endeavor until it satisfies the cost, time, and quality limitations applied to it. However, it is not uncommon to see a construction project failing to achieve its goal within the specified cost, time, and quality. Aibinu and Jagboro (2002) studied the effects of construction delays on project delivery in Nigerian construction industry. The six effects of delay that were identified includes: time overrun, cost overrun, dispute, arbitration, total abandonment and litigation. Koushki and Kartam (2004) concluded that time and cost overrun was the impact of the material selection time, their availability in the local market and the presence of the supervising engineer. It is important to improve the estimated activity duration according to the actual skills levels, unexpected events, Efficiency of work time, mistakes and misunderstanding (Lock, 1996). Delays influence negatively on the contractors performance and contribute to adverse impacts in construction projects such as contract disputes, low productivity and increase in construction costs that will also influence on the pre-determined of construction project objectives.

Murali Sambasivam, et al (2007) studied the effects of construction delays on project construction industry. The six effects of delay identified were:

1) Cost overrun
2) Time overrun
3) Dispute
4) Arbitration

5) Litigation and

6) Termination /Abandonment

2.6.1 Cost Overrun

Regarding cost overrun Koushki et al., (2005) identified three main causes that were contractor related problems, material-related problems, and owners$_6$ financial constraints, whereas Wigunaand Scott (2005) identified the most critical factors included: high inflation/increased material price; design change by client; defective design; weather conditions; delayed payment on contracts and defective construction work.

2.6.2 Disputes

Disputes are the effects of major causes of delays in construction projects such as causes of Client related, Contractor related, Consultant related and external related that may be arisen during the construction projects among the project parties. Lack of communication may also leads to misunderstandings, conflicts and disputes. Hence it necessitates the project managers to have effective communication skills which are one of the significant soft skills (People skills)with the project parties involving in construction projects. Based on Murali et al., (2007) the factors such as lack of communication between the various parties, problem with neighbors, unforeseen site conditions, delay in payments for completed work, improper construction method, delay caused by the subcontractor and discrepancies in contract documents will give rise to disputes between the various parties. Furthermore, if the disputes cannot be solved amicably or easily it can lead to arbitration or litigation.

2.6.3.1 Arbitration

According to Murali et al., (2007) delays caused by either client or contractor related factors such as change order; delayed progress payment, contractor's non-performance and lack of communication between parties which may raise disputes will be settled through arbitration process. For these circumstances, it is necessitate having a competent third party that can settle the disputes amicably or easily without going to court.

2.6.3.2 Litigation

Based on Murali et al., (2007) when the delays caused by client related, contract related, labor related and external related factors such as delay in payment for completed works, problems with site conditions and less labor supply where eventually rise the disputes to be settled by the litigation process. The parties involved in the construction projects use litigation as a last alternative to settle the disputes.

2.6.3.3 Contract Termination.

The most critical adverse effect of delays in construction projects is abandonment that could be temporary or in worse condition for permanent duration. The major causes of client related, consultant related, contractor related and external related may lead to project abandonment that will lead to delays in construction projects. Aibinu and Jagboro (2002) studied the effects of construction delays on project delivery in Nigerian construction industry. They identified total abandonment as one of the major effects of delay.

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1. Organization of the Research

The methodology considered and adopted for this research work focus on literature review and, structured questionnaire survey was designed and employed to assess the knowledge and practice to analyze cause and effects of delays in the this water supply design and construction project. It also uses a mixed research method (both quantitative and qualitative methods) in the data collection process.

- ✓ The quantifiable responses will be analyzed through a quantitative method as the name implies.
- ✓ The qualitative data gives more emphasis to the non-quantifiable responses and it is chosen due to its flexible nature. In recent time, the responses gathered through questionnaires are becoming less reliable as the respondents did not give due attention to the outcomes, it is essential to strengthen through interviews and face to face discussions.

Therefore, the qualitative method used to support the quantitative data that was collected in the research. Finally, based on the obtained data and results of the analysis, conclusions and recommendations are provided.

3.2. Study Project

The selected study project of this research is *Legedadi* deep wells water supply design and construction project (phase I) located partly in *Oromia* special zone and partly in the city of Addis Ababa.

3.3. Target Participants

In this study determined numbers of volunteer participants are included. As this study is intended to get in-depth information about the knowledge and practice in the design and construction of water supply projects, it is good to have enough sample size. The participants that are included in this research were selected based on the following inclusion criteria's.

- ✓ The participant must be registered GC or BC of Grade 3 or above, Consultants and project Owners.
- ✓ Individual participants must be professional engineers/architects in general and water supply engineers in particular and willing to participate in the research.
- ✓ It is preferable that the participants should be those involved in the design and construction of specifically on the selected research project and also those participated in similar construction projects.
- ✓ The participant should have experience in study and design, construction supervision, contract management at any water supply projects.

3.4. Data Collection Method

The required data were collected by using a well prepared and pretested questionnaire. A questionnaire was developed in order to assess the perceptions of different parties involved in the construction process in Ethiopia's water construction sector, for the evaluation of frequency of occurrence and importance of the identified causes. Data gathering from large sample size participants is time consuming and require high budget. To overcome such challenges, I prefer to collect the required information from those

involved in study, design and construction of water supply projects by using questionnaire. The questionnaire was divided into three parts;

- ✓ The first part, Section -A consisted of questions about the general profile, information and background of the respondents.
- ✓ The second part, Section -B comprised of questions regarding the most frequent and important causes of construction delay in water supply project were asked in both design and construction stages.
- ✓ The third part, Section-C focused on the most important and frequent effects of construction delay in relation to LDWWSP.

The questionnaire was designed to be a close ended questions including with few comment spaces. These types of questions had a number of choices of possible answers and the respondents selected whatever they feel was most appropriate. The reason for selecting a questionnaire method for my research is because it has a merit of giving adequate time for informants to respond, not easily approached respondents can be reached conveniently, large sample members can be addressed, and economically cheap. Similarly, the closed ended questions were also selected because they are easier to assess and answer considering how busy the respondents were.

In addition, unstructured one-to-one interview was conducted with carefully selected individuals represented major contracting parties and actively participated at different responsibility levels in the construction of LDWWS project. Meanwhile, contractual matters were reviewed by the researcher to verify participants' responses.

3.5. Data Analysis

The data analysis is determined to establish the relative importance of various factors that Contribute to causes and effects of construction delays. Analysis of data consists of calculating the Relative Importance Index (RII) and Ranking of factors in each category based on the Relative Importance Index (RII).

CHAPTER 4

4. FINDINGS AND DISCUSSION

4.1. Introduction

The findings and discussion below is divided in three parts corresponding to the research questions and also the sections of the questionnaire. The first part presents survey distribution and response rates by sector organization, respondents' designation and experience in the Ethiopian building construction industry. The second part of the results and discussion contains the findings of the questions directed towards identifying the importance of delay causes and raking in the level of their severity. 51 potential delay causes were selected from previous studies and grouped in category wise.

These delay causes had a five point scale ranged from 1 to 5 in a level of importance from Nonimportant to Extremely Important cause to project delays and the results are discussed. In the third part respondents were asked to identify the most important and frequent effect of construction delay.

Similarly to the causes, nine potential effects were selected from previous studies. These effects of delay had also a five point scale ranged from 1 to 5 and the results of the questions are presented and discussed accordingly.

4.2. Survey Distribution and Response Statistics

4.2.1. Survey Response

A total of 75 questionnaires were distributed among the respondents of different backgrounds working on large water construction projects in general and on LDWWSP in particular.

The distribution mainly focused to the people involved on LDWWSP on behalf of project owners, contractors/Sub contractors and consultants.

Out of 75 questionnaires distributed 54 (72%) were returned.

4.2.2. Statistics of Respondents

The following tables, Table 4.1 and 4.2 show the general information and distribution profile of the respondents 'organization in terms of type and respondents designation respectively (Appendix-B, Section-A).

Table: 4.1- Respondents Organizational profile

Questionnaire Distributed and Returned			% of return Vs distribution
Representing Organization	**Questionnaire Distributed**	**Questionnaire Returned**	
Client/Owner	30	25	83.33
Consultant (Engineer/Designer)	20	14	70
Contractor	20	12	60
Subcontractor	5	3	60
Total	**75**	**54**	**72**

Table: 4.2 - Respondents Designation

Respondents Position (3Cs)		
Position	**Number**	**Percentage**
Project Manager (Engineers)	8	14.81
Project Coordinator	11	20.37
Site Engineer	13	24.04
Office Engineer	4	7.41
Contract administrator (Engineers)	4	7.41
Site Supervisors	14	25.93
Total	**54**	**100**

The designation of the respondents shows a relatively wider variety of responsibility levels which are relevant to the design and construction delay analysis.

The respondents have been assigned as senior project managers, Project Coordinators, Site and Resident engineers, contract administrators, Office engineers and construction supervisors.

As shown on the following table, respondents' general and specific work experience in study, design and construction of water supply projects and in construction industry are described respectively.

Table: 4.3 - Respondents Experience

General and Specific Experience				
No. of years	**General experience**	**Percentage (%)**	**Specific experience**	**Percentage (%)**
0 to 5 years	0	0	5	9.26
6 to 10 years	4	7.41	7	12.96
11 to 15 years	5	9.26	10	18.52
16 to 20 years	9	16.67	11	20.37
Above 20 years	11	20.37	19	35.19

As per the percentage of years of work experience of the respondents in the above table 4.3,

- 9.26% to 20.37% of the respondents have 5-11 years of specific work experience and 35.19% of the respondents have above 19 years of specific experience.
- 7.41% to 16.67% of the respondents have 4-9 years general work experience and 20.37% of the respondents have 11 years of general work experience

4.3 Responses on General Factors of causes and Effects of delay

The Design and construction caused delay is universally evident reality and is counted as a common problem in construction projects. Delays in construction projects happen because of various factors and causes. These causes classified by seven factor groups.

- Clients related factors
- Contractors related factors
- Consultant related factors
- Material related factors
- Equipment related factors
- Labor related factors and
- External factors

In this respect the respondents were asked (Appendix B, Section-B) to rank the importance general factors of delay causes using five points scale(1=Very low, 2= Low, 3= Average, 4= High and 5= Very High).Participants were also asked to add any related issue or comment that are not included in the space provided for each factor group unfortunately, no one given additional comment on the space provided in the questioner on all the three sections(Appendix B).

The importance and ranking of delay causes resulted by the research methodology of questionnaire survey and evaluated by statistical formula for each factor group are shown below.

Table: 4.4- Importance and ranking of Resources and capabilities

No	Factors	Rating					RII	Ranking
		1	2	3	4	5		
1	**Employer (25)**							
1.1	Finance Resource	2	3	6	6	8	**0.720**	1
1.2	Technical Competence	4	9	7	5	0	**0.504**	5
1.3	Leadership (Projects)	4	8	6	4	3	**0.552**	4
1.4	Experience (Projects)	3	2	8	8	4	**0.664**	2
1.5	Incentive System	3	10	3	6	3	**0.568**	3
2	**Consultant (14)**							
2.1	Finance Resource	0	2	5	7	0	**0.672**	5
2.2	Technical Competence	0	1	2	6	5	**0.814**	3
2.3	Leadership (Projects)	0	0	4	4	6	**0.829**	2
2.4	Experience (Projects)	0	0	2	5	7	**0.871**	1
2.5	Incentive System	0	2	4	5	3	**0.729**	4
3	**Contractors & Sub (15)**							
3.1	Finance Resource	0	0	3	5	7	**0.853**	2
3.2	Technical Competence	0	1	2	6	6	**0.827**	3
3.3	Leadership (Projects)	0	0	3	7	5	**0.853**	2
3.4	Experience (Projects)	0	0	3	4	8	**0.867**	1
3.5	Incentive System	1	2	5	4	3	**0.680**	4

As results shown in the above Table 4.4, respondents ranked the most important client related delay causes in the design and construction of '*Legedadi* deep Wells water Supply Project (Phase-I) as follows;

- Unrealistic contract duration and imposed requirements, RII= 0.728 ranked First.
- Finance arrangement and inadequate budget allocation and poor coordination and communication both were ranked second, RII= 0.704
- Change and Variation order during construction ranked third, RII=0.688 and
- Client interference ranked forth, RII= 0.624

Table: 4.5 –Relationship strength with other parties.

No	Factors	Rating					RII	Ranking
		1	2	3	4	5		
1	Clients with (25) (Contractor and Consult)	0	2	11	7	5	0.333	7
2	Consultants with (14) (Client and Contractor)	0	1	3	6	4	0.786	6
3	Client, Consultant and Contractor with (54) (Government)	0	0	13	20	21	0.830	3
4	Contractor/Supplier with(15) (Client and Consultant)	2	3	1	4	5	0.693	1
5	With Workers (54) (Client, Consultant and Contractor)	2	5	16	18	13	0.730	2

Note: (25), (54) etc. denotes number of respondents.

As shown on the above table 4.5, the most important and highly ranked contractor and subcontractor related delay causes in the construction of LDWWS project are as follows;

- Rework due to error during construction ranked first with RII Value of 0.680.
- Delay in sub-contractors (JV) work ranked second with RII value of 0.613 and
- Both poor coordination and communication and inappropriate construction method ranked third with RII value of 0.587.
- The forth ranked issue is inaccurate cost estimate.

Table: 4.6–Total organizational performance level of Employer and the Consultant.

No	Factors	Rating					RII	Ranking
		1	2	3	4	5		
1	**Employer (25)**							
1.1	On time Delivery	5	7	8	4	1	**0.512**	7
1.2	Quality of performance	0	1	3	6	4	**0.568**	5
1.3	Timely Decision	4	7	6	5	3	**0.544**	6
1.4	Improvement in monitoring and Evaluation of projects	2	6	5	7	5	**0.656**	2
1.5	Reduced time and cost overrun	3	5	7	7	4	**0.624**	4
1.6	Internal relationship growth	0	8	7	6	4	**0.648**	3
1.7	Team working growth	0	7	6	7	5	**0.680**	1
2	**Consultant (14)**							
2.1	On time Delivery	0	2	2	4	6	**0.800**	2
2.2	Quality of performance	0	1	3	5	5	**0.800**	2
2.3	Timely Decision	0	1	5	4	4	**0.757**	4
2.4	Improvement in monitoring and Evaluation of projects	1	4	3	4	2	**0.629**	6
2.5	Reduced time and cost overrun	0	4	4	3	3	**0.671**	5
2.6	Internal relationship growth	0	1	5	3	5	**0.771**	3
2.7	Team working growth	0	0	5	2	7	**0.829**	1

Note: (25), (54) etc. denotes number of respondents.

As shown on the above table 4.6, the most important and highly ranked Employer related delay causes in the construction of LDWWS project are as follows;

- Team working growth ranked First with RII Value of 0.680.
- Improvement in project Monitoring and evaluationranked Second with RII value of 0.656.
- Internal organizational relationship ranked Third with RII value of 0.648.
- The Forth ranked issue is Reduced Cost and time overrun with RII value of 0.624
- Quality of performance is ranked Fifth with RII value of 0.568 and
- Timely decision and on time delivery ranked Sixth and seventh respectively with RII values of 0.544 and 0.512.

In addition, consultant related issues are scored the following;

- Team working growth ranked First with RII Value of 0.829.
- On Time delivery and Quality of performance both ranked Second with RII values of 0.800
- Internal organizational relationship ranked Third with RII value of 0.771.
- Timely decision ranked Fourth and seventh respectively with RII values of 0.757
- The Fifth ranked issue is Reduced Cost and time overrun with RII value of 0.671
- Improvement in project Monitoring and evaluation rankedSixth with RII Value of 0.629

In general, both the Employer and the Consultant scored relatively low on issues related Timely decision and reduced time and cost overrun.

4.4. Responses on Specific Factors of Causes and Effects of delay

In this respect the respondents were asked (Appendix B, Section-C) to rank the importance Specific factors of delay causes using five points scale(1=Very low, 2= Low, 3= Average, 4= High and 5= Very High).Participants were also asked to add any related issue or comment that are not included in the space provided for each factor group unfortunately, no one given additional comment on the space provided in the questioner on all the three sections (Appendix B).

Table: 4.7 -Importance and ranking of Employer related delay causes

No	*Issues*	*Rating*					*RII*	*Rank*
		1	*2*	*3*	*4*	*5*		
1	**Study and Design Stage (25+14=39)**							
1.1	Sufficient time was given for study/Design	0	2	8	13	16	0.821	2
1.2	Sufficient manpower was deployed	6	6	12	8	7	0.621	6
1.3	Sufficient input data were used for S & design	0	0	9	16	14	0.826	1
1.4	Wells have been all drilled and their yield were known	0	0	9	16	14	0.826	1
1.5	Sufficient field investigation was performed.	0	0	9	16	14	0.826	1
1.6	All required data from the client were provided	0	0	10	16	13	0.815	3
1.7	All the required design data were available	0	0	10	16	13	0.815	3
1.8	All BOQ documents were prepared correctly.	0	2	10	14	13	0.795	4
1.9	Client has given his comment on all project documents at draft, final draft and final reports.	2	7	12	9	9	0.682	5
1.10	Client has given sufficient assistance during study & design	2	7	12	9	9	0.682	5

As indicted in the above Table 4.7, the most important client related causes of delay occurred during study and design stage of LDWWSP/Stage I are the following:

- Insufficient Design data inputs, wells data and field investigation (RII=0.826)
- Unrealistic Duration of or work schedule for study and design (RII=0.821),
- Poor Clients participation during study and design stage in providing available data and close follow-up (RII=0.815)
- Inaccurate engineering Cost estimation (BOQ), RII=0.795
- Insufficient Clients support during study and design stage in providing comments on design documents in time (RII=0.682)

Table: 4.8 -Importance and ranking of Consultant related delay causes

No	*Issues*	*Rating*					*RII*	*Rank*
		1	*2*	*3*	*4*	*5*		
2	**Construction Stage (25+15=40)**							
2.1	Poor contract management	6	6	10	15	3	0.615	4
2.2	Complexity of site Investigation	7	10	13	5	5	0.555	6
2.3	Shortage of qualified & sufficient manpower	7	10	13	5	5	0.555	6
2.4	Delay in design approval by the consultant	2	8	12	9	9	0.675	3
2.5	Design errors and revisions	2	8	12	9	9	0.675	3
2.6	Site management & Construction supervision	3	10	15	8	4	0.600	5
2.7	Poor engineering estimate preparation (BoQ)	1	3	7	14	15	0.795	1
2.8	Mistakes and inconsistency in design document	0	5	8	14	13	0.775	2
2.9	Slow redesigning process	1	4	7	15	13	0.775	2

As described in the above Table 4.8; the following Consultant related factors are scored relatively high inthe construction stage which contributes delay on the project construction performance.

- Poor contract management, Lack of timely decision by both related to the employer and the consultant and also,
- Reworks due to design change, slow redesigning process and poor engineering cost estimation (BOQ).

Table: 4.9 -Importance and ranking of Contractor related delay causes

No	*Issues*	*Rating*					*RII*	*Rank*
		1	*2*	*3*	*4*	*5*		
2	**Construction Stage (39)**							
2.1	Poor contract management	2	4	11	14	8	0.713	3
2.3	Shortage of qualified & sufficient manpower	0	3	18	9	9	0.723	2
2.4	Delay in Payment	0	6	13	12	8	0.713	3
2.8	Machinery and Equipment capacity	4	7	8	10	11	0.703	4
2.9	Poor site management & Construction supervision	0	2	18	10	9	0.733	1
2.13	Delay in testing construction material samples.	0	2	18	10	9	0.733	1
2.14	Construction materials quality and delivery	0	3	17	11	8	0.723	2
2.15	Lack of timely decision	2	3	19	9	6	0.677	5
2.16	Financial capacity	0	2	12	16	9	0.579	6
2.17	Frequent rework due to contractors problem	2	4	14	12	7	0.559	6
2.18	Labor relationship	5	4	16	9	5	0.544	7
2.19	Lower productivity of Labor and equipment's	3	6	15	8	7	0.518	8

As described in the above Table 4.9; contractors related factors for delay are minimal.

However,

- ✓ Site management and construction supervision and delay in materials testing related (RII=0.733)
- ✓ Construction materials quality and delivery related (RII=0.723)
- ✓ Poor contract management and delay in payment related delay (RII=0.713)
- ✓ Machinery and equipment related (RII=0.703)

As the researcher's opinion, the contractor does not contribute much to the project delay.

Table: 4.10 -Importance and ranking of consequences after completion of the project

No	*Issues*	*Rating*					*RII*	*Rank*
		1	*2*	*3*	*4*	*5*		
3	**After Construction (25)**							
3.1	Excess pipes and fittings are observed	0	0	2	6	17	0.920	1
3.2	High effect on the client's revenue collection plan due to delay	0	2	6	7	10	0.800	3
3.3	Customers grievances were high due to late service delivery	4	5	8	5	3	0.584	6
3.4	Positive Image of the project owner were faded	5	4	7	5	4	0.592	5
3.5	There are Quality problems of the constructed project	4	7	6	5	3	0.568	7
3.6	There is operation & maintenance problem by the client	3	6	7	3	6	0.624	4
3.7	Maintaining operational sustainability may not be possible.	0	0	4	8	13	0.872	2
3.8	Problems are occurring due to unaddressed social issues	0	0	2	6	17	0.920	1

The questions have been distributed mainly to the Employer to get the feedback about the problems observed or faced starting from commissioning date.

As the questionnaire survey showed that, the refined problems which are known after the handover of the project are as follows (Table 4.10).

- ✓ Excess Pipe and Fittings are purchased due to design error by the consultant and may be due to lack of close follow-up of the project by the Employer during design stage. (RII=0.920).
- ✓ Problems arise because of unaddressed social issues (RII=0.920) and due to this maintaining operational sustainability is under risk (RII=872)
- ✓ Due to delay, Employer's revenue collection plan has not been achieved (RII=0.800)
- ✓ Operational and maintenance cost is increasing time to time (RII=0.624 due to this frequent water supply interruption is occurring.

Table: 4.11 - Importance and ranking of External delay causes (all Respondents)

Delay Causes	Rating					RII	Ranking
	1	2	3	4	5		
Delay in obtaining ROW	12	20	8	8	6	**0.511**	2
Rise in price of material	25	14	15	0	0	**0.363**	5
Weather condition	12	18	20	4	0	**0.460**	4
Unforeseen site condition	0	0	27	15	12	**0.744**	1
Delay in providing services from utilities (water/electricity	15	17	13	5	4	**0.474**	3

As shown on Table 4.11 above, the most important and highly ranked external factor of delay causes in the construction of LDWWS project are:

- Unforeseen site condition (RII=0.744),
- Delay in obtaining permit (RII=0.511),
- Delay in providing services from utilities (water, electricity, etc) (RII=0.474),
- Weather condition (RII=0.460) and
- Delay in rise in price of material (RII=0.363).

Table: 4.12 - Importance Index for Most Important Factors from Overall Results

No	Delay Causes	RII	Factors (Category)
1	Inaccurate design data inputs	0.826	Employer
2	Wells yield Data (10 wells) availability	0.826	Employer
3	Insufficient field investigation performance	0.826	Employer
4	Sufficient time was given for study/Design	0.821	Employer
5	All required data from the client were provided	0.815	Employer
6	All the required design data were available	0.815	Employer
7	BOQ documents were prepared incorrectly.	0.795	Consultant
8	Incorrect engineering cost estimate preparation (BoQ)	0.795	Consultant
9	Delay in design approval by the consultant	0.675	Consultant
10	Mistakes and inconsistency in design document	0.775	Consultant
11	Slow redesigning process	0.775	Consultant
12	Design errors and revisions	0.675	Consultant
13	Machinery and Equipment capacity	0.703	Contractor
14	Poor contract management	0.774	Contractor
15	Poor site management & Construction supervision	0.733	Contractor
16	Delay in testing construction material samples.	0.733	Contractor

As shown on Table 4.12, from the overall results obtained from the questionnaire response, causes of delay that hamper the performance as well as timely delivery of the project are presented in the level of their severity in the Employers, Consultants and Contractors perspective.

4.5 Top Delay Causes

In Table 4.12 above, as ranked by the respondent, 15 most important factors caused delay in '*Legedadi* Deep Wells water Supply Design and Construction Project (Phase I)' are summarized and presented.

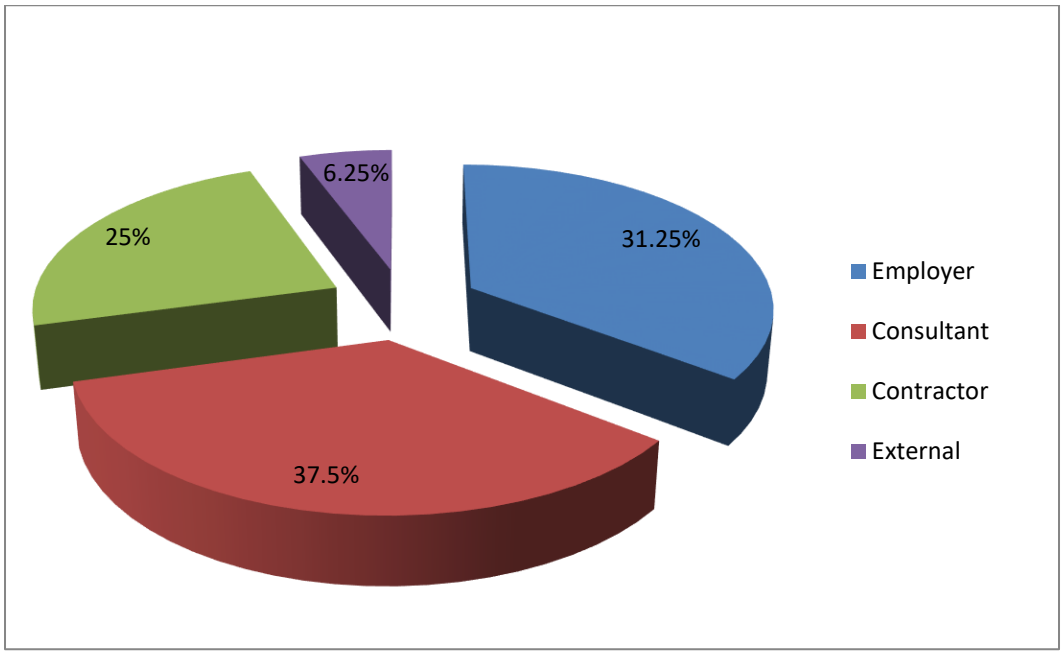
a) Inaccurate or incomplete design data inputs (Optimum yield of 10 Production wells) and insufficient field investigation performance by the Consultant with RII=0.826.
b) Incorrect Engineering cost estimation which includes supply and construction (BOQ) preparation by the consultant RII=0.795.
c) Poor Contract management by the contractor RII=0.774
d) External factor, unforeseen site condition RII=0.744

Furthermore unreliable study and design work schedule with RII=0.821and Mistakes and inconsistency in study and design documents of the project with RII=0.815.

There are many more causes, but selected more important causes and high ranked (Table 4.12). These causes lead to the effects broadly discussed in chapter 5.

Figure 4.1 below shows, besides the influence of unbalanced questionnaire distribution among parties, according to respondents' ranking, out of the top twenty most potential delay causes, 37.5% originated by the consultants, 31.25% originated by the Employer, 25% originated by the contractors and 6.25% ranked as originated by external factors.

Figure: 4.1 Percentage distributions of delay causes by origin agents



4.6 The Importance and Ranking of Effects of Delay by respondents

The desire to finish a project on time, under the planned budget, and with the highest quality is common goals for all contracting parties, including the Owner, Contractor and Consultant. Delay usually result in losses of one form or another for everyone. The causes lead to the effects of delay on construction projects. The Fife effects of delay identified were:

1) Time overrun

2) Cost overrun

3) Wastage and underutilization of resources

4) Tying down of Client's capital due to excess material purchase.

5) Decrease in income generation/revenue collection and

4.7 FINDINGS SUMMARY OF THE RESEARCH

The outcome of analysis from this study can be said to be of great relevance to the construction industry. As indicated in Table 4.3, Majority of the respondents are fully involved in the water supply design and construction projects with;

- ✓ 18.52% of the respondents have 11-15 years of specific experience on water supply design and construction projects,
- ✓ 20.37% of the respondents have 16-20 years of specific experience on water supply design and construction projects,
- ✓ And 35.19% of the respondents have above 20 years of specific experience on water supply design and construction projects.

In general, almost all respondents are well experienced and believed to have rich knowledge and could supply the necessary information on the question sent out in the questionnaires. The professionals represented were the Clients having 46.30%, Contractors and sub-contractors having the percentage of 27.78% and the third one, the consultant having the least percentage of 25.93%.

Analysis was also carried out on the effect of delay on the project work. Time overrun, increase in final cost of project, wastage and under-utilization of man-power and resources, tying down of client capital due to excess material procurement due to design mistake by the consultant and of course weak follow-up of the project owner, Employer.

Time is factor that is very essential in all activities that has to be carried out, in the contract document a specific time phase is given for the two project stages (study and design and construction stage) to complete the required project and if the time is being

exceeded more money is often spent which could lead to increase in final cost of project and also causes public grievance due late service delivery.

CHAPTER 5

5. ANALYSIS OF THE CASE STUDY

The city of Addis Ababa is one of the cities in a rapid development course in all aspects in Africa. The city is the seat of central Government of Federal Democratic Republic of Ethiopia (FGDRE) and Africa Union Head Quarters (AU) and different diplomatic missions are reside in the city and now a day's Addis Ababa is considered as a capital city of Africa. On the other hand the population growth of the city is high and different huge investments including Housing projects are undergoing. due to this, existing water supply scarcity becomes increasing time to time and the need of developing new additional potable water sources becomes among prioritized tasks of the city Administration of Addis Ababa and central Government.

Due to this, Study, Design and Construction of different new water supply projects have been made and one of the Project Constructed in this program has been '*Legedadi* Deep Wells water Supply Construction Project (Phase I) to supply North East part of the city specifically expansion areas which is the selected case study.

LDWWSP is one of the water supply projects implemented to alleviate the prevailing unsatisfactory water supply situation at the capital city, which is an important service for one of the most water deficit areas of the city-Eastern &North Eastern Addis Ababa. The project is based on ground water source, specifically of 10 deep wells in *Legedadi* well field with a maximum discharge of 54,000 m^3/day. The conveyance system starts from *Legedadi* to *Ayat* square through *Legetafo, Yeka Abado* and *Yeka Ayat*. And it distribute

to *Yeka Abado, Yeka Ayat, Bole Summit, Bole Ayat* and *Bole Arabsa* condominium sites as well as the nearby residents.

Table 5.1- Key players on the Selected project case study

Project Name	Project Owner	Consultant	Contractors
LDWWSDCP (Phase I)	AAWSA	Water & Energy Design & Supervision works sector. (Formerly WWDSE)	CGCOC JV with Feljas & Masson

5.1 *Legedadi* Deep W.W.S. Design and Construction Project (Phase I)

The expected benefits of the project have been to safely store and transport and supply 40,000 m^3/d of potable treated water from a ground water potential located at *legedadi* area *(LegeBeri, Lege Bolo Kebele* and *Dabe Muda GudoKebele)* and distribute to the newly constructed condominium houses which has no access to the existing water supply system in the expansion area in *Yeka Abado, Yeka Ayat, Bole Ayat, Bole Summit* and *Bole Arabssa* addressing 69,000 houses which is about 276,000 inhabitants at 4 person per house.

The project at the beginning has been designed to a total capacity of satisfying a daily demand of 333,333 inhabitants at a daily consumption rate of 120 l/c/head and the surplus water after supplying condominium houses is planned to distribute to existing system to alleviate water shortage of nearby areas and reinforce the central part of the city. While designing the water supply system, the necessary complete data of all ten wells drilling results was not obtained, discharge of 7 wells and some other design imputes were assumed. Due to this, after drilling completion of the remaining 7 wells the

total production increased to 54,000m^3/d which can satisfy 450,000 inhabitants per day at 120l/c/d consumption rate.

Table 5.2- Beneficiaries by location

No	Condominium Name	Residents
1	*YekaAbado*	85,990
2	*YekaAyat*	53,880
3	*Bole Ayat*	20,000
4	*Bole Summit*	60,000
5	*Bole Arabssa*	103,625
	Total Beneficiaries	**323,415**

Source of the following problems are caused primarily from using inaccurate assumption design inputs during project designing process;

- Big difference in total supply and installed quantity/Length of water pipes.
- Affects project construction time table due to design revision.
- Design review and change of Electromechanical equipment
- Late service delivery and
- Affects revenue collection plan of the client.

As per the original plan or signed contract agreement, the project is supposed to be completed in 12 months (One year) with the total allocated budget of ETB ***1.35*** Billion while due to time overrun the project have been completed in 15 months (One year and 3 months) and consumed at the end of the project ETB 1.41 Billion which is higher by ETB 0.06 Billion or 4.44% than the contract amount which creates challenges to allocate

additional budget on the client side. Additional to this, inefficient service delivery on the project owner, Addis Ababa Water and Sewerage Authority.

5.1.1 Location of the case study;

Legedadi Deep wells water supply project is a water supply project from a source of 10 deep wells having an average depth of above 500m in localities of *LegeBeri, Lege Belo kebele* and *Dabe Muda kebeles* in *Legedadi* area of *Oromia* special zone at a distance of 30km from Addis Ababa in North East direction along *Desse* road.

Collector water pipes installed in the well field, Main water conveyance system from well field up to *Kotebe* and distribution system covers *Kotebe, Ayat,*and Summit and Bole *Arabssa area.*

Figure: 5.1- General layout of the case study project

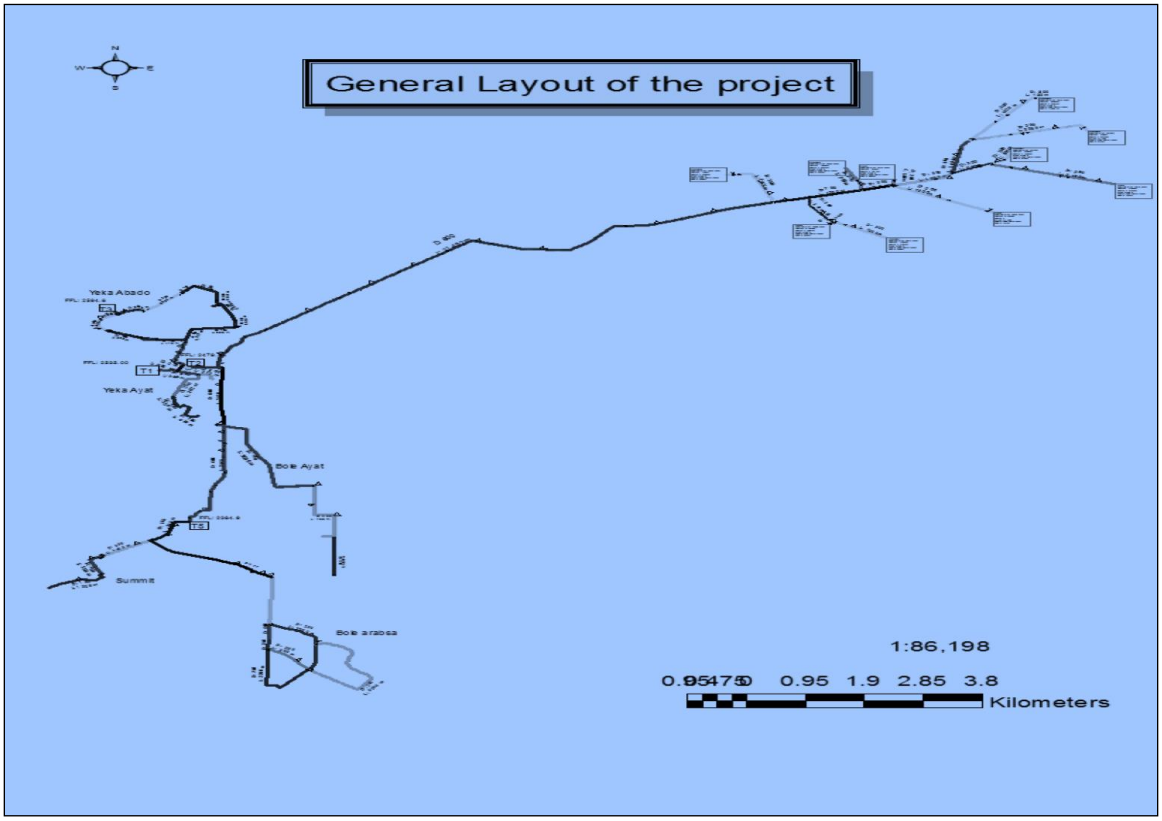
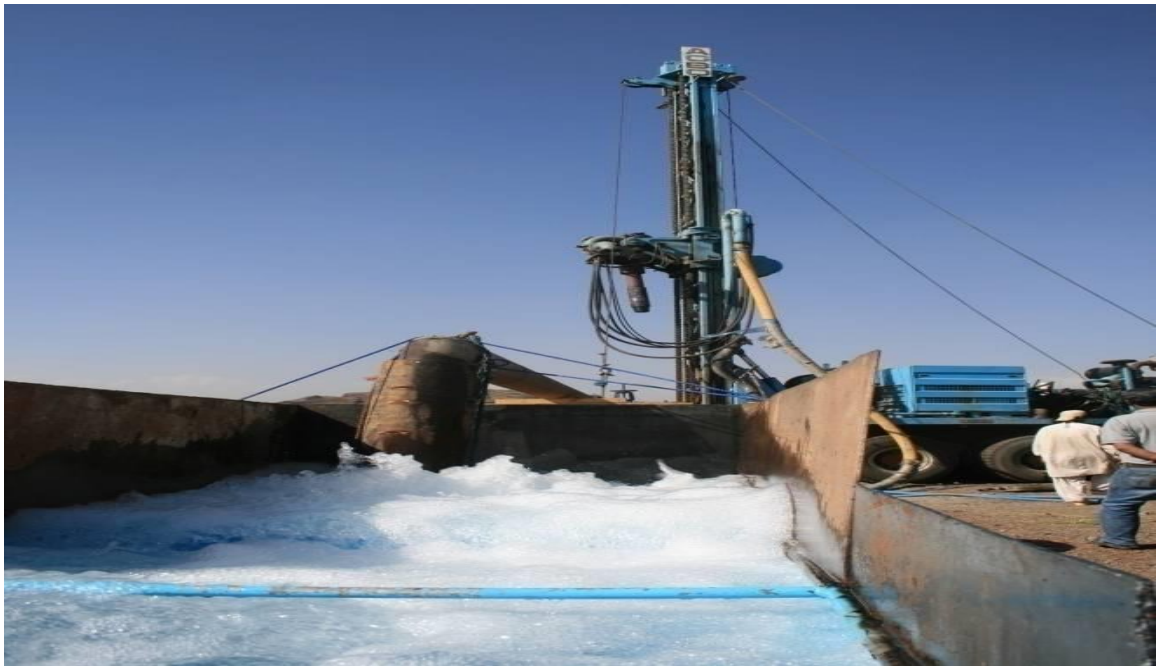


Figure: 5.2-Well pumping test process to determine the optimum yield of each well



5.1.2 Project Planning.

As per the data collected from the Consultant andProject owner (Employer), the project implementation plan have been divided in the following two major Stages;

- ❖ Study, Design and Construction Stage and activities to be performed are listed in the following Table.

Table; 5.3- Activities at Design and Construction stage

Study and Design Stage	Construction Stage
Preliminary Field investigation	Construction supervision
Inception report preparation	Contract administration
Detail filed investigation	Progress report preparation
Draft design report preparation	Design review and schedule control
Final design report	Interim Payment approval
EIA assessment Report	Testing and commissioning
Bill of Quantities document preparation	Completion report preparation
Cost estimate preparation	Follow-up in liability period
Tender document preparation	Final acceptance

5.1.2.1 Study and Design stage.

As per the data collected from project documents and face to face discussions specifically with the consultant all activities have been finalized within only three months (October to December 2013) and the expert explains that, during negotiation with the project owner the consultant discussed strongly to make the study and design schedule at least six month but due to excess pressure from the client they signed the contract.

5.1.2.2 Construction Stage.

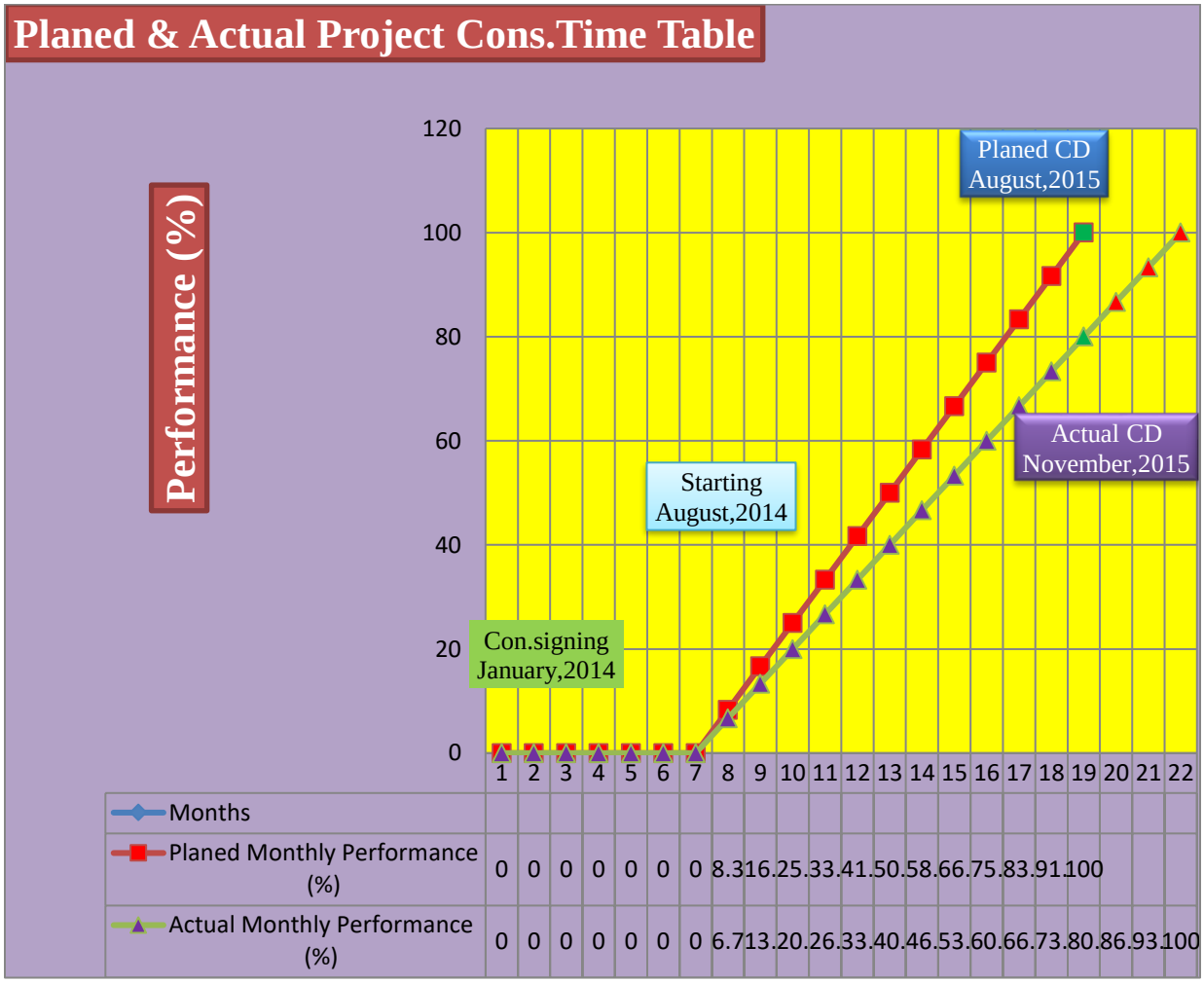
The construction work have been given by direct award to the Chinese contractor, *CGCOC* JV with *Feljas* and *Masson* French electromechanical contractor and after three month negotiation the contract have been signed in April 2014 and started in August 2014 to complete and commission within 12 months, August 2015.

However, due to factors related to the consultant, client and contractor the project have been commissioned and put into service after 15 months in November 2015 which shows 3 month delay.

Table 5.4- Particulars of LDWS Project (Phase I)

Project Particulars	**Descriptions**
Employer /Project Owner	Addis Ababa Water and Sewerage Authority
Consultant	Water Infrastructure design and construction supervision sector
Contractor	CGCOC with JV *Feljas* and *Masson*
Direct beneficiaries size	450,000
Contract signed date	January, 2014
Project starting date	August , 2014
Original Project Duration	12 months
Actual completion date	November, 2015
Total delay	3 months
Project Location	North East of A.A, Partly in *Oromia* special zone *Legedadi* locality and partly in North East of AA.
Contract Type	Admeasurements
Project funding agency	Addis Ababa Water and Sewerage Authority
Original Contract Amount	ETB 1,347,963,056.82 including 15% VAT
Variation Amount	ETB 60,000,000.00 including 15% VAT
Revised Contract Amount	ETB 1,408,796,834.31 including 15% VAT

Figure: 5.3- Project Time Table.



5.1.3 Contract Original Project Scope.

The project has been organized in two contracts, Civil and electromechanical works including materials supply.

Major components of the project are described as shown in the following table 5.5.

Table: 5.5- Design Components of the project

No	Study and Design Stage	Unit	Quantity
1	Construction of control rooms (HCB)	No	11
2	Supply and installation of Collector, Transmission and Distribution pipe lines	Km	107.52
3	Steel pipe bridge construction at river crossing	No	6
4	Construction of pump station including, Chlorine building, Generator building,	No	3
5	Construction of water reservoirs (2,000, 5,000 & 10,000$m^{3)}$	No	5
6	Construction of all weathered access road in well field	Km	14
7	Construction of Toilets, Septic Tanks, Guard House, Compound works, Fencing, operators building, Transformer seat etc.	No	101
8	Construction of standby power generator shade	No	10
9	Supply and Installation of Electrical and Mechanical equipment: - Submersible Pumps including well head - Electrical Panel boards - Surface Pumps - Radio communication system & computer Control system	 No No No Set	 10 15 5 1

5.1.4 Original Budget allocation by Contracts.

The required budget for Supply and construction has been allocated by the Ethiopian Government and Administration office of Addis Ababa City.

The total allocated budget based on the original design is described below;

Table: 5.6-Original allocated budget for supply and construction

No	Descriptions	Unit	Amount
1	Civil works including supply (Cont.-I)	Birr	1,141,347,560.77
2	Electromechanical Works including Supply (C-II)	Birr	206,615,496.05
	Total Amount including VAT (15%)	Birr	***1,347,963,056.82***

5.2 Design Changes

The original design have been amended three times accordingly the project cost shows variations. Amendments are caused mainly due to Design changes in both Civil and EM Contracts and major variations are described hereunder.

Table: 5.7-Variation Quantities caused by Design Changes

No	Study and Design Stage	Unit	Design Qty	Actual Qty	Difference
1	Supply & installation of Collector, Transmission and Distribution pipe lines	Km	107.52	85.21	**+22.31**
2	Steel pipe bridge construction at river crossing	No	6	4	-2
3	Construction of water reservoirs (2,000, 5,000 & 10,000$m^{3)}$	No	5	4	-1
4	Construction of all weathered access road in the well field	Km	14	24	**+10**
5	Construction of Toilets, Septic Tanks, Guard House, Compound works, Fencing, operators building, Transformer seat etc.	No	101	96	-5
6	Supply and Installation of Electrical and Mechanical equipment: - Surge Vessels	No	0	12	**+12**

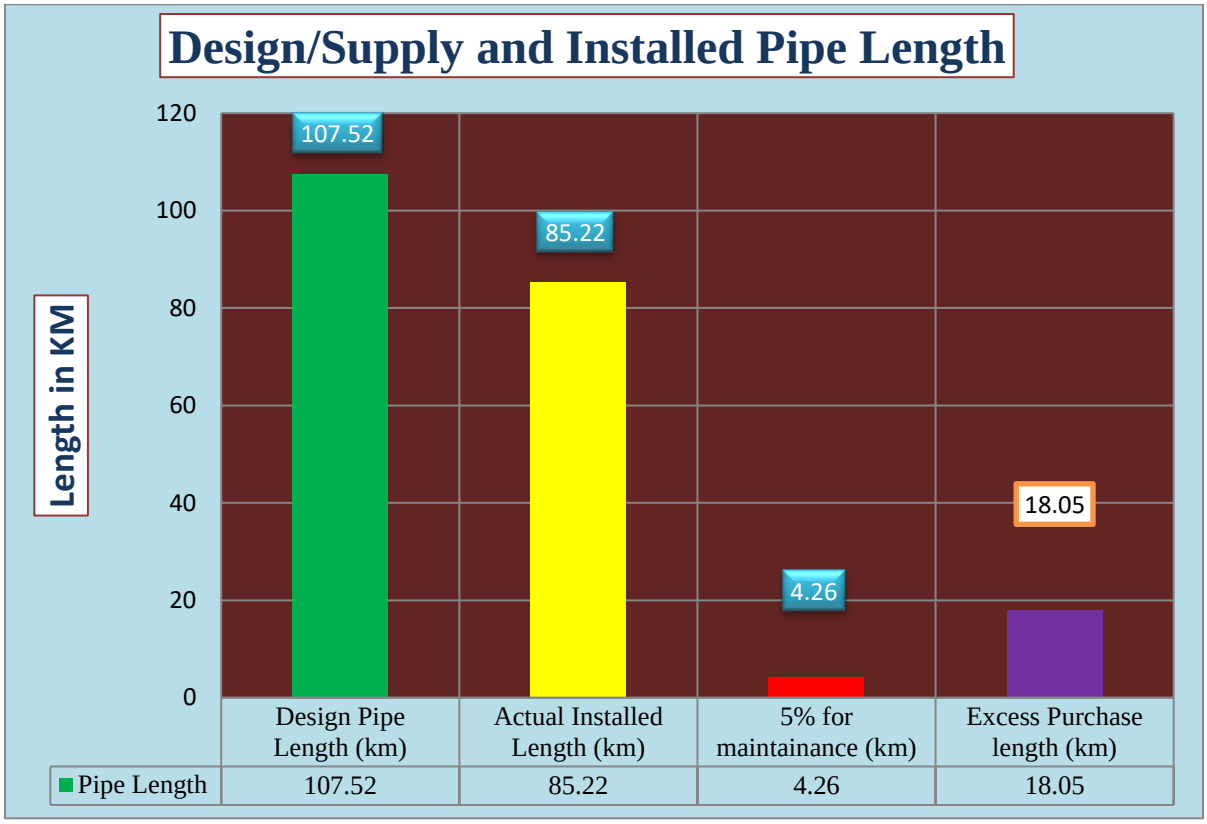
From the above table, we can see that major changes in quantity due to design errors or changes specifically on materials purchased from abroad (No. 1 and 6) which requires foreign currency and affects the country's economy.

In civil work contract (Cont.-I), Design quantity of pipes and fittings purchased from abroad exceeds by 16.80% (18.05km) after deducting 5% (4.26km) for maintenance purpose than the total length of pipes installed at the end of the project.

On the other hand on contract II, Electrical mechanical works 12 surge vessels which are not considered in the original design has been purchased from France and installed and this change has been caused due to wrong data input during design analysis. Estimated Yield of 7 deep wells

has been low based on only 3 wells drilled result at the time of designing. Which means at the design stage 40,000m^3/d of water have been estimated and after drilling completion of Ten wells, the total production reached to 54,000m^3/d due to this design change was mandatory.

Figure: 5.4-Difference in Supply and actual Installed pipe length.



5.3 Cost and Time Overrun

5.3.1 Cost Overrun

At the end of deign preparation the contract have been signed with Chinese and French contractors with a total amount of ETB 1,347,963,056.82 including 15% VAT and at the end of construction ETB 1,408,796,834.31 has been consumed. Additional budget allocated or variation amount is about ETB 60,833,777.49 including 15% VAT or

exceeds by 4.51% while the overall work volume is found less than the original volume indicated in the contract document example;

- ✓ Pipe installation work.
- ✓ Steel Pipe Bridges including reinforced concrete pipe supports.
- ✓ Construction of concrete water Reservoirs
- ✓ Construction of Toilets, Septic Tanks, Guard House, Compound works, Fencing, operators building, Transformer seat.

Table: 5.8-Cost overrun effect caused by design changes.

No	Descriptions	Unit	Amount	Actual Cost
1	Civil works including supply (Cont.-I)	Birr	1,141,347,560.77	1,195,759,951.25
2	Electromechanical Works including Supply (Cont.-II)	Birr	206,615,496.05	213,036,883.06
	Total Amount including VAT (15%)		***1,347,963,056.82***	***1,408,796,834.31***
	Additional Cost consumed (I+II)/ETB		***+ 60,833,777.49***	

5.3.2 Time Overrun

At the end of deign preparation the contract have been signed (January 2014) and construction have been started in August 2014 by Chinese and French contractors to finalize and put into operation within 12 months (August 2015). Due to different factors the project has been completed within 15 months (November 2015) which shows about 3 months delay.

The project time table has been extended by 25% (3 months) than the original construction plan.

5.4 Cause of Delay

As indicated under 5.1.2.2 above, the project has been commissioned after three months delay and as per the discussions with the designers and project design documents, the following are the main causes of delay or time overrun.

5.4.1 Client Related Causes of Delays

Due to the urgency nature of the project, the client did not undertake evaluation of design documents produced by the consultant in different stages.

Therefore, valuable comments were not given to the consultant on draft and final design reports. Time and cost overrun could have been minimal if proper and strong feedback were forwarded to the consultant to make a correction.

5.4.1.1 Unrealistic Design contract duration

Due to the urgency nature of the project, the client directly negotiated with the consultant without inviting other similar consultants and the consultant requested 6 month for study and design works while the client put high pressure on the consultant to do the required design work within three months' time.

Accordingly, the consultant forced to accept and start the design work due to this design revision has been rampant during construction period which causes time and cost overrun at the end.

5.4.2 Consultant related causes of delays

5.4.2.1 Mistakes and discrepancies in design document

Design revision has been continuously undergoing starting from project commencement date and after complete review of the pipe network the final length becomes 89.48 km which includes 4.26 km reserve for maintenance purpose. While based on the original design 107.52 km length pipes have been purchased from China which is in excess by 16.80% as a result of Consultant's error during preparation of detail design.

5.4.2.2 Inaccurate site investigation during design period

The following are among identified causes of delay related to the consultant or clients representative.

- Poor and shallow Site investigation,
- Inaccurate design documents, contract and technical specifications,
- Un realistic contract duration, three months for study design work and
- Slow performance in reviewing the design

5.4.2.3 Inaccurate design Data Inputs

During the study and design work, only 3 deep wells out of ten have been drilled and proper pump test have been performed to determine the optimum yield of each wells based on this, total production of ten wells have been estimated to 40,000m^3/d.

While at the end of well drilling of the remaining seven wells, the result becomes completely different than the average value considered as an input for the whole and this brings the total daily production increased to 54,000m^3/d. due to this, all design analysis

related to pipe network and electrical mechanical works have been redone and becomes one major reason for the cost and time overrun.

5.4.2.4 Slow Response to Contractor's Request

The consultant has an obligation to respond in the soonest possible time to any request of the contractor on behalf of the client which can help to minimize or avoid contractor's claims or time and cost overrun. In this case study, the consultant has been spending longer time to review and deliver the revised design to the contractor which causes at the end three month delay.

5.4.3 Contractor's related causes of delays

Surprisingly, there was no significant delay causes related to the contractor while the contractor has been trying to assist the consultant and the client to enhance design revision works.

The researcher has got the chance to see most of communication letters between the consultant and the contractor and number of letters written by the contractor which requests designclarification, decision, warning and similar letters are rampant while did not resound in time and satisfactorily for outstanding requested issues.

5.5 Effect of Delay

5.5.1 Effect on Revenue Collection.

Due to three month (September, October and November 2015); the project owner revenue collection plan has not been achieved. About a total of ETB 20,007,000.00 Has been planned to collect in three months' time based on the daily production of

54,000m^3however due to three month delay, the planed revenue collection was not realized.

Table: 5.9 – Current water tariff of Addis Ababa (Domestic Rate)

No	Water consumption range (M^3)	Rate/M^3 (ETB)
1	0 - 7	1.75
2	8 - 20	3.80
3	21 - 40	4.75
4	41 - 100	5.95
4	101 - 300	7.45
5	301 - 500	9.45
6	Above 500	11.60

Figure: 5.5-Unharvested volume of water due to time overrun.

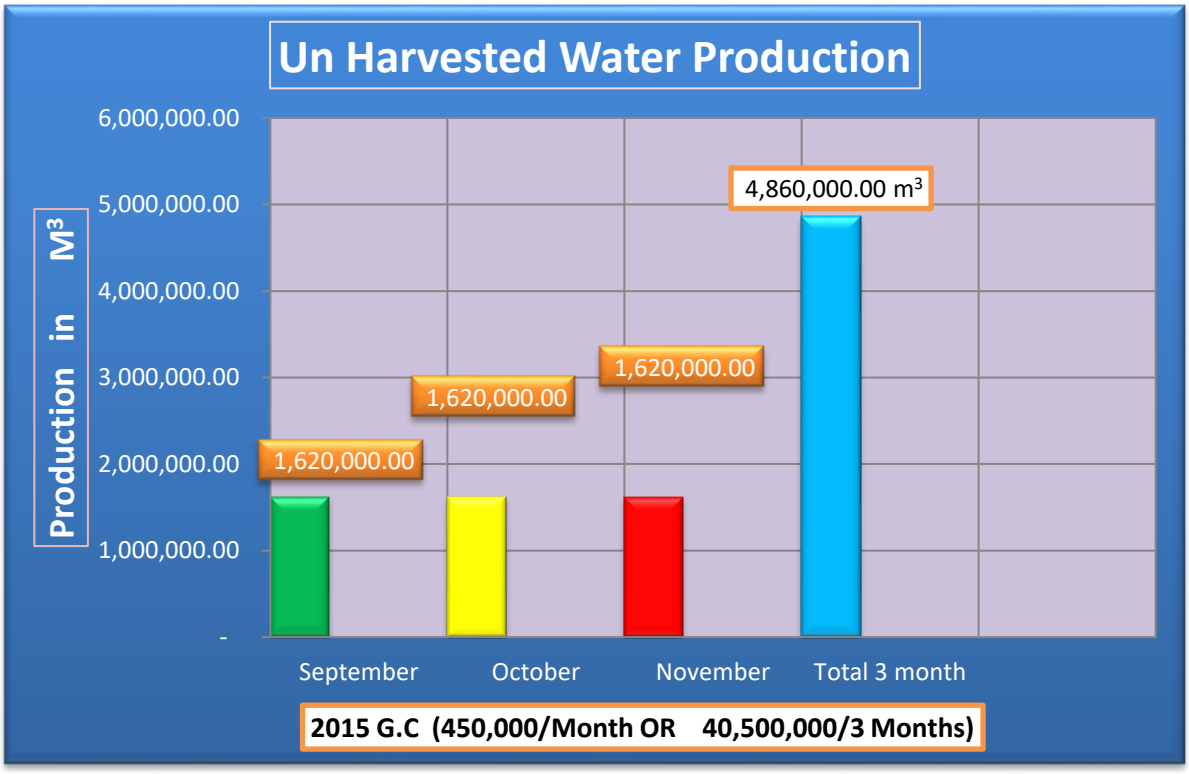


Table: 5.10 –Lost Revenue (Domestic)

No	Water Consumption Range (M^3)	Current Water Tariff (ETB/M^3)	Water Production (M^3/Month)	Revenue Collection plan (ETB/Month)	Revenue Collection plan (ETB/ 3Months)
1	0 - 7	1.75	1,080,000.00	4,104,000.00	12,312,000.00
2	8-20	3.80	540,000.00	2,565,000.00	7,695,000.00
Total Lost Revenue (ETB)			**1,620,000,000.00**	**6,669,000.00**	**20,007,000.00**

The first two lowest water tariff rates are considered from domestic rates listed in Table 5.9 to calculate the lost revenue by the project owner in three month times.

To be on the safe side, $2/3^{rd}$ of the total monthly water production ($1,620,000m^3$) is taken and calculated at ETB $1.75/m^3$ which is the least tariff and the remaining $1/3^{rd}$ of monthly water production has been calculated using ETB $3.80/m^3$ tariff rate.

At large, the project owner lost a total amount of ETB 6,669,000.00 in one month and ETB 20,007,000.00 in three months' time and this shows clearly haw the project owner is negatively affected.

5.5.2 Effect on Good Service delivery.

Promise has been announced repeatedly to the public through mass media about the delivery day of potable water to the residents of condominium houses in the expansion area.

However, the project has been completed and put into service in November 2015 after Three month delay and this creates public grievance due to low performance of the project owner.

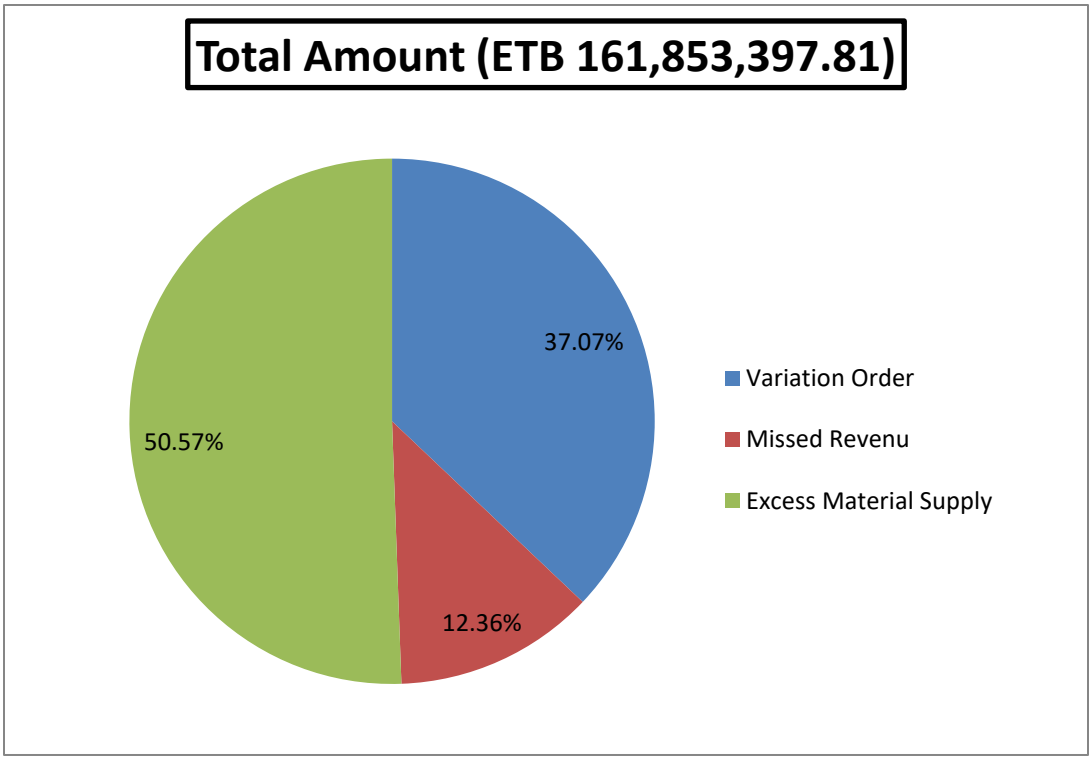
5.6 Total Financial Effects Caused due to Design Error.

Clear design error observed on the consultant side and also the Employer is also part of the problem due to unsatisfactory follow-up during study design and construction stage at the end the Employer lost quite a big amount of many which was able to build medium size water supply project for the public.

Total estimated cost caused by mainly due to design changes, Delay and excess material purchase is estimated about ETB 161,853,397.81. Details and percentage shares of each factor are described as follows;

- ✓ Variation due to design change ETB 60,000,000.00 (37.07%)
- ✓ Missed revenue due to delay ETB 20,007,000.00 (12.36%)
- ✓ Excess material supply (Tied budget) ETB 81,846,397.81 (50.57%)

Figure; 5.6 – Total cost estimated caused by the three Factors



While on the other hand, when the effects of the three factors compared with the total project design volume (project cost, Supply and 3 month delay) we clearly visualize the following total effects;

- Project cost increased by 19% due to design changes (Variation orders).
- 25% excess material purchases which Tides' huge amount of budget due to design error.
- 3 month planned revenue from water selling, which is 6% is not realized.

CHAPTER 6

6. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter includes the summary, conclusions and recommendations that would help in solving the occurrence of delay and its effects at the construction of Water supply projects as a whole and in Addis Ababa in particular.

The primary general objective is to identify the principal Causes or factors responsible for delays and their effect on the progress; as well as timely delivery.

6.1 Summary

And the specific objectives of the study have been;

1. To explore construction project delays related to project study and design document Preparation works.
2. To identify Causes and Impacts of delay factors that currently exist water supply Design and construction projects by exposing the most common and fundamental Problems affecting project delivery performance.
3. To briefly survey major potential Causes and Impacts of delays from different Stakeholder's perspective.
4. To identify the success factors which are most influential in avoiding or preventing Delay factors.

In order to achieve the above objectives of the study, review of literature was conducted. Data were collected using various methods and analysis was conducted to come with the findings of the study

6.2. Conclusions

Based on the literature reviews, the results of questionnaire responses and case studies the following conclusions are drawn.

A. The following causes are identified as a potential delay causes on the projects

1) Mistakes and discrepancies in design documents, frequent design change During construction, inaccurate site investigation and incorrect data inputs for Design analyses which all are the consultant's responsibility;

2) Unrealistic time table (3 months) for the study and design tasks causes delay And adverse financial implication. And these are caused by both the Consultant and Employer.

3) Weak follow-up of the study and design works, non-responsiveness in evaluating and giving reliable comments on draft and final design report to the consultant goes to the project owner.

4) Findings of the case study witnessed that *Legedadi* deep wells water supply design and construction project (Phase I) have been completed and put into operational after three month delay

B. Time overrun, cost overrun, loss of unutilized (idle) resources and tying down of client's capital, negative effect on revenue collection of the client annual plan and public grievance are the effects of the delay encountered during construction.

C. Besides all, other non-quantifiable delay damages like inability to provide service to the customers as per the work schedule and promise and loss of client opportunities to get water caused public grievances.

6.3 Recommendations

These delays are badly affected the *Legedadi* Deep Wells water Supply Design and Construction Project (Phase-I) and it is needed to find a solution for countering the delays. The solution to avoid and/or to counter delays is to avoid and lessen the causes related with delays, It is suggested to deal with the causes and find a solution so that these causes not happen or happen very less. Based on the findings of the research, the following recommendations were proposed.

6.3.1Expectations from Consultants

The survey results indicated that the majority of delay factors are relevant to Consultants. Therefore, the following corrective measures are expected from consultants;

- Consultants should produce a clear, conclusive and adequately detailed design and working drawings as per the planed time table.
- The consultant should always be able to give realistic and justifiable advices to the employer and whenever there is unrealistic order or request from the employer, it is the consultant's responsibility to not accept and convince the employer with strong justifications.
- Consultants should have clear and all-inclusive understanding on client necessities and complete project information to avoid unnecessary construction delay and should act ethically and professionally.
- Consultants should respond as quickly as possible to contractor and client questions and requests for clarification to avoid associated delays
- Avoiding delaying the response to contractor's queries as well as the approval the submitted submittals and shop drawings.

6.3.2 Expectations from Clients

- The client should determine the required duration of project and impose realistic duration to avoid time and cost overruns at both design and construction stages.
- Specification of a realistic duration in the contract for the consultant and Contractor to execute the study and design work and construction of the project.
- The Employer should closely follow the study and design process and give comment as required at draft and final level of project design report. This can reduce design change and variation during the construction stage.
- The Employer should provide the consultant all the available reliable data to be considered as an input during design stage.
- Making sure field investigations during study and design stage are done as required and complete, strong and free of errors and/or contradiction.
- Hiring experienced consultants for design and construction supervision and contractor in water supply projects of work who has a good reputation.
- The Employer needs to establish Development of a monitoring and periodical reporting of critical and long lead items and periodically providing a narrative explanation of causes of any experienced delay.
- Development of a good system for site management and supervision also develops effective planning and scheduling for the project.

6.3.3 Expectations from all parties

- All Project parties and Stakeholders shall be involved actively starting from design stage and construction stage and this will help much in minimizing project delay and time and cost overrun.
- Formal relationships among project parties should be clearly identified, as well as roles and responsibilities.

7. SUGGESTIONS FOR THE FURTHER RESEARCH

This study mainly focused on only one project, *Legedadi* deep wells water supply design and construction project (Phase I). Hence future wider studies on delay causing factors could be done constantly with their mitigation measures. Similar studies conducted in other countriescould be considered to see cross country comparison and to have a more global view of delay factors in the construction sector.

Specific studies in specific projects that experienced significant delay could also be conducted using similar approaches used in the current study.

At large, research needs to continue in order to refine and find more effective mechanism to minimize if not avoid, causes and effects of project delays which are currently a chronic challenge of our country, Ethiopia.

REFERENCES

1. Hamed Samarghandi1, Seyed Mohammad Moosavi Tabatabaei2, Pouria Taabayan3, Ahmad Mir Hashemi4, 'Studying the Reasons for Delay and Cost Overrun in Construction Projects' (2016, Malaysia, v.*21(1), pp.51–84*:

2. WorkuKoshe, K.N.Jha 'Investigating Causes of Construction Delay in Ethiopian Construction Industries', (2016) DireDawa, Ethiopia.

3. Mohamed M. Marzouk ,Tarek I. El-Rasas 'Analyzing delay causes in Egyptian onstruction projects' (2012). v. pp.51-55, Egypt.

4. ZinabuTebejeZewdu 'Construction Projects Delay and Their Antidotes: The Case of Ethiopian Construction Sector (2016) Ethiopia.Vol. 5, 113-122

5. ShewaferahuTilahun, 'Cause and Effects of Delay on Educational Building Projects in Addis Ababa University' (2016) Addis Ababa, Ethiopia

6. PärKarlsson, 'Project Management in Sweden and Ethiopia', (2011) Sweden, pp.43-67

7. Dr. DavendraVerma, 'Study on project schedule and cost overrun (Infrastructure projects)', (2012) New Delhi, India. pp. 7-33

8. The Associated General Contractors of America, 'Guidelines for a Successful Construction Project' (2003) America.pp. 32-54

9. N. Hamzah, M.A. Khoiry, I. Arshad, N. M. Tawil and A. I. CheAni, 'Cause of Construction Delay Theoretical Framework', (2011) Malaysia. v. pp.491-494

10. Shabbab Al Hammadi1, M. SadiqueNawab,'Study of Delay Factors in Construction Projects', (2016) KSA, v. 3, pp.91-93

11. Nabil Al-Hazim, Zaydoun Abu Salem, Hesham Ahmad, 'Delay and Cost Overrun in Infrastructure Projects in Jordan', (2017) Jordan, v. pp. 18-24

12. United Nations Organization (UNOPS), 'Design Planning Manual for Buildings'. (2014), pp. 35-184

13. African Development Fund, Project Completion report of Harar Water Supply and Sanitation Project, (2013), pp-10

14. Abedi, M., Fathi, M. S. & Mohammad, M. F. (2011). Major Causes of construction Delays under Client Category and Contractor Category, Malysia. pp. 4-5

APPENDIX – A
THESIS PROPOSAL

1. INTRODUCTION

The city of Addis Ababa is one of the cities in a rapid development course in all aspects in Africa. The city is the seat of central Government of Federal Democratic Republic of Ethiopia and Africa Union Head Quarters and different diplomatic missions are reside in the city and now a day's Addis Ababa is considered as a capital city of Africa. On the other hand the population growth of the city is high and different huge investments including Housing projects are undergoing. due to this, existing water supply scarcity becomes increasing from time to time and the need of developing new additional potable water sources becomes among prioritized tasks of the city Administration of Addis Ababa and central Government.

Due to this, Study, Design and Construction of different new water supply projects have been made and one of the Project Constructed in this program has been ***LDWWSP,*** **'Legedadi Deep Wells Water Supply Design and Construction Project (Phase I)** to supply North East part of the city specifically expansion areas.

LDWWSP is one of the water supply projects implemented to alleviate the prevailing unsatisfactory water supply situation at the capital city, which is an important service for one of the most water deficit areas in Bole and Yeka sub cities.

Source of water, 10 deep wells are located in Legedadi well field with a maximum discharge or production of 54,000m^3/day. The conveyance system starts from Legedadi to Ayatsquare through Legetafo, YekaAbado and YekaAyat. And it distribute to YekaAbado, YekaAyat, Bole Summit, Bole Ayat and Bole Arabsa condominium sites as well as the nearby existing residents.

The project at the beginning has been designed to produce 40,000m^3/d which has a total capacity of satisfying a daily demand of 333,333 inhabitants at a daily consumption rate of 120 l/c/head and the surplus water after supplying condominium houses was planned to distribute to existing system to alleviate water shortage of nearby areas and reinforce the central part of the city. While designing the water supply system, the necessary complete data of all ten wells drilling results was not obtained, discharge of 7 wells and some other design imputes were assumed. Due to this, after drilling completion of the remaining 7 wells the total production increased to 54,000m^3/d which can satisfy 450,000 inhabitants per day at 120l/c/d consumption rate.

Incorrect assumption inputs and may be design errors during the design process may be caused by;

- Big difference in total supply and installed length of water pipes.
- Affects project construction time table due to design revision.
- Design review and change of Electromechanical equipment's
- Late service delivery and
- Affects revenue collection plan of the client.

As per the original plan or signed contract agreement; Study, design and construction of the project is supposed to be completed in 15 months with the allocated budget while due to time overrun the project have been completed in 18 months (One year and 6 months) which causes inefficient service delivery on the project owner, Addis Ababa Water and Sewerage Authority.

This thesis will examine causes and Impacts of delay in an integrated manner and determines how critical delay causes are most influential in project performance. This

will provide owners, Consultants and construction organizations involved in construction projects with the foundation on which such strategies on how to avoid delays can be developed in the future

2. PROBLEM STATEMENT

Delays in a Study and Design or construction projects is counted as a common problem worldwide and became a cause for projects completion with huge cost overrun (requiring higher budget than estimated), extended completion time, inferior quality deliverables and contract termination. In recent time it was an accepted phenomenon to have delays in construction projects completion time.

For the client, construction delay is a:

- ✓ Loss of revenue,
- ✓ Lack of productivity,
- ✓ Dependency on existing facilities,
- ✓ Creates public grievance etc.

For the contractor, construction delay is:

- ✓ The higher costs,
- ✓ Longer work duration,
- ✓ Increased labor cost,
- ✓ Higher material and equipment costs etc. Completion of construction projects on

Specified time or time agreed by the parties indicates their efficiency. The delays in construction projects happen because of various factors or causes. These causes lead to

the delay in construction completion, and this delay ultimately leads to negative effects on the construction project.

In Ethiopian construction practice, it is very rare that construction projects are completed on the time specified or agreed upon. There are many infrastructure design and construction projects in Addis Ababa, which suffered delay or in some cases suffered suspension or abandonment. Therefore this study is aimed at investigating the causes and effects of delays in Legedadi deep wells water supply design & construction project (Phase I).

3. RESEARCH QUASTIONS

The following will be the research questions of this study:

1. To what level does the project owner participate in evaluating and commenting On Draft and Final design reports submitted by the Consultant?
2. What are the major problems faced by the consultant during study and design Process of the project?
3. What are the major problems associated with the project design documents?
4. What are the major causes and Impact of delay on the project?
5. How much revenue is lost by the owner of the project due to delay?

4. RESEARCH OBJECTIVE

4.1. General objectives

The general objective of this study is to assess the major causes and Impacts of delays on 'Legedadi Deep Wells Water Supply Design and Construction Project (Phase I) on the successful completion of the project.

The primary objective is to identify the principal Causes or factors responsible for delays and their effect on the progress; as well as timely delivery.

4.2.Specific Objectives

1. To explore construction project delays related to project study and design document Preparation works.
3. To identify Causes and Impacts of delay factors that currently exist water supply design and construction projects by exposing the most common and fundamental problems affecting project delivery performance.
4. To briefly survey major potential Causes and Impacts of delays from different Stakeholder's perspective.
4 To identify the success factors which are most influential in avoiding or preventing delay factors.
5 To suggest recommendations that would help address the problems associated with delays of design and construction projects.

4.3 Scope of the Study

The scope of this research is limited to the study, design and construction of Legedadi Deep Wells Water Supply Project in Addis Ababa (Phase I) which constructed to supply potable water to resident expansion areas located in North East of the city.

The study will cover starting from preconstruction stage, study and design stage, construction and commissioning stage of the project and research data is expected from the designers having different professional disciplines participated in both design and construction supervision tasks of the project, professionals participated in the project starting from the beginning up to hand over stage and also contractor's professionals.

5. LITRATURE REVIEW

5.1. **General**

A „construction project‟ is a high value, time bound, special construction mission of creating a construction facility or service, with predetermined performance objectives defined in terms of quality specification, completion time, budgeted cost and other specified constraints (Chit Kara, 2011).Time and Cost are among the five main parameters that can sufficiently define a construction project. Other parameters are scope, quality and resources. The five parameters are interactive, that is, each parameter is a function of other. The evaluation and balancing of interrelationship among the five project parameters is a complicated process. However, in a given project, the scope and quality of work in terms of quantity and specifications are specified and these parameters are not subjected to change (unless scope changes substantially). Resources and costs are co-related. Therefore, for a given quality, in such situation, time, cost and scope are core parameters. These parameters are interlinked and must be kept in balance to achieve project objective efficiently and effectively within changing environments (Chit Kara, 2011).

The development of Time and cost estimates that accurately reflect project scope, economic conditions, and are attuned to community interest and the macroeconomic conditions provide a baseline cost that management can use to impart discipline into the design process. Projects can be delivered on budget and Time table but that requires a good starting estimate, project management discipline and an awareness of factors that can cause delay and cost escalation (Shane et al, 2009). Construction time serves as a benchmark for assessing the performance of any project. Due to unexpected problems

encountered during Conception, designing & construction phase often led to unwanted delay in project completion.

The construction project consists of three phases namely: Conception/designing, bid and Construction/build (DBB). Timely completion of projects is an indicator of efficient construction industry. Construction time often serves as a benchmark for assessing the performance of a project and the efficiency of the project organization. A project is said to be successful on timely completion. The time required to complete construction of projects is often more than specified time in Contract. These ‘overruns‘ or, time extensions happens due to many reasons, such as designer changes or errors, economic conditions, resource availability and performance of project parties.

Usually, majority of project delay occurs during Construction phase, where unforeseen factors (environmental concerns and restrictions, ground conditions etc.) are always involved. Construction delays lead to increase in overall project cost, henceforth completing projects on time is beneficial to all parties involved in projects. Therefore, it is essential to identify the actual causes of delay in order to minimize and avoid the delays and their corresponding expenses.

A timely completed project is usually regarded as ‘successful’ within budget and to the level of quality standard as specified by the client at the outset of the project. In fact, the realization of the present complex construction projects involves the co-operation and co-ordination of various parties including the clients, consultants, contractors, subcontractors, and suppliers (Churns and Bryant, 1984). However, the way in which the client organizes and manages the project will also exert a significant influence on subsequent project outcomes.

According to Chit Kara, 2011 the main controllable causes of the projects‟ Delay and cost overruns include but are not limited to the following:

- ✓ Inadequate project formulation: Poor field investigation, inadequate project information, bad cost estimates, lack of experience, inadequate project formulation and feasibility analysis, poor project appraisal leading to incorrect investment decisions.
- ✓ Poor planning for implementation: Inadequate time plan, inadequate resource plan, inadequate equipment supply plan, inter-linking not anticipated, poor organization poor cost planning.
- ✓ Lack of proper contract planning and management: Improper pre-contract actions, poor post-award contract management.
- ✓ Lack of project management during execution: Insufficient and ineffective working, delays, changes in scope of work and location, law and order.

5.2.Project Delay studies in Malaysia.

Construction industries are a growing industry in Malaysia. Fundamentally, construction activities are derived from the local economic activities in Malaysia. Construction of non-residential and residential buildings contributed between 40 to 55 percent of the total construction market between 2006 and 2009.

KPKT (2010) define the project delay is the project who are experiencing delays in construction period where different gaps between the actual in progress sites work compared to the work scheduled which is between 10% to 30%. Meanwhile sick project is the project are experiencing delays in construction period where gap between actual

work progresses compared to the work scheduled is more than 30% or the projects are failed to complete in the construction period.

Failure to achieve: targeted time, budgeted cost and specified quality result in various unexpected negative effects on the projects. Usually, when the projects are delayed, they are either extended or accelerated the time and therefore, invite to the additional cost. Although the contract parties agreed upon the extra time and cost associated with delay, in many cases there were problems between the owner and contractor as to whether the contractor was entitled to claim the extra cost. (MuralSambas Ivan, 2007).

A numbers of project delay cases are recorded. The first case is at main campus of University Malaysia Kelantan and second case of delay is a construction of research complex in National University of Malaysia, Bangui. Both cases are experienced delay. Delays give increase to disturbance of work and loss of productivity, late completion of project increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to reduce the possibility of delay occurrence or identify it at early stages. (Salah Al HadiTumi, 2009).

5.3.Project Delay Studies in Saudi Arabia

In Saudi Arabia Assafet.Al, 2006 conduced a research about construction project delay on different type of project in the state. It was concluded that **70% of projects experience time overrun.** The survey was conducted with 23 contractors, 19 consultant and 15 owners. Seventy-three cause of delay was recognized and the causes are grouped into nine classes. The outcome of the survey that agreed by all three parties is ***change order***. The overall results are stated that the factor related to labor, contractor, project,

owner and consultant are in the highest rank. Consultants play a very important role in design-related delays because they are in charge of the design process in conjunction with the owner of the project. Furthermore delayed in payments categories do not have the same negative impact on project completion times as other factors considered in this study such as code, design and construction related issues.

Al-Ghfly, (2005) identified that, project owner involvement, contractor performance and the early design and planning of projects are important factors for the project delay in Saudi Arabia. The study discussed delay in public water and sewage projects. Sixty causes were identified and classified. He concluded the following: the delay occurred frequently in medium and large size projects, and considered severe in small projects. Important delay causes are related to owner involvement, contractor performance, and the early planning and design of the project. Important delay causes were found to be: financial problems, changes in the design and scope, delay in making decisions and approvals by owner, difficulties in obtaining work permit, and coordination and communication problems.

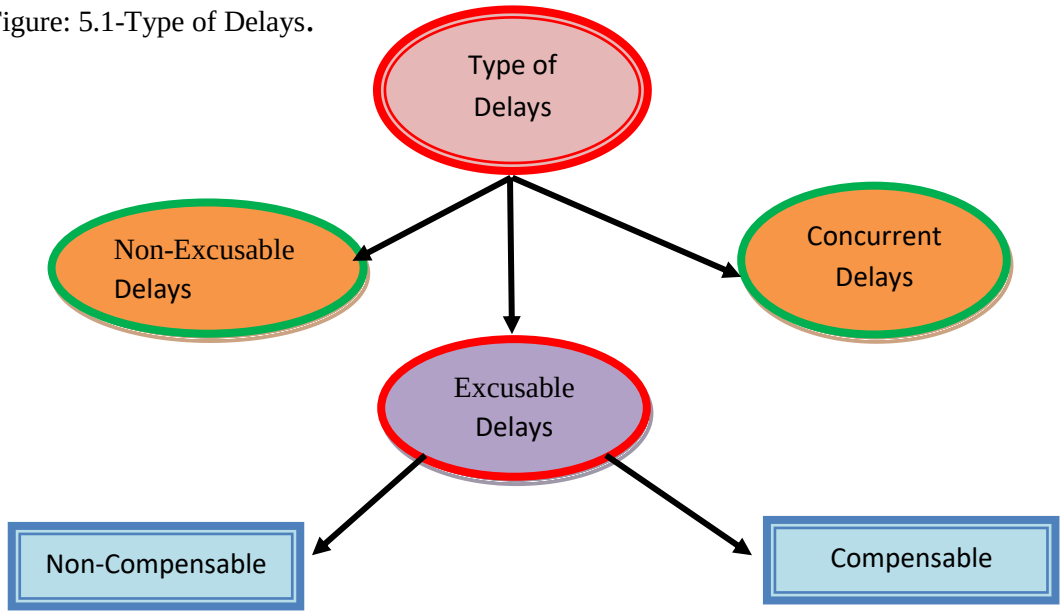
The study recommended to owners (Timely payment to contractor, minimum change in order during construction, timely reviewing and approving of design documents, checking resources and capability of contractor), contractors (sufficient number of labors, managing financial resources, proper planning and scheduling, better site management and supervision), and consultants (timely reviewing and approving design documents, flexibility in evaluating contractor works).

5.4.Project Delay Studies in Jordan.

130 public projects in Jordan have been investigated the causes of delay by Al-Momani, (2000) in year 2000. The whole projects indicated that poor design and carelessness of the owner, change orders, weather condition, site condition, late delivery, economic conditions, and increase in quantities are the main causes of delay. The presence of these factors has an impact on the successful completion of projects.

Review of Type of Delays

Figure: 5.1-Type of Delays.



As shown on Figure 5.1, there are **three types of delays** Non-Excusable delays, Excusable delays and Concurrent delays (Saleh Al HadiTumi, 2009).

- A non-excusable delay is delay caused by the contractor or its suppliers, through no fault by the owner. The contractor is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. Therefore, non-excusable delays usually result in no additional money and no additional time being granted to the contractor.

- Excusable delays are divided into two: compensable and non-compensable delays. Compensable delays are caused by the owner or the owner's agents. While non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. These delays are commonly called “acts of God” because they are not the responsibility or fault of any particular party. (Wa’elAlaghbari, (2007) and Saleh Al HadiTumi, (2009)
- The Third type of delay factor is called Concurrent delay. a more complicated one and this is very typical in construction project. This situation happened when more than one factor delays the project at the same time or in overlapping periods of moment.

6. Research Methodology

Research method will be formulated to address the research questions and meet the objectives through theories based on contextual realities of the study area.

6.1 Research Arrangement

The methodology to be considered and adopted for this research work focus on literature review and, structured questionnaire survey was designed and employed to assess the knowledge and practice on the cause and effects of delays in Legedadi deep wells water supply design and construction project.

It also will use a mixed research method in the data collection process that are;

- The quantifiable responses will be analyzed through a quantitative method.
- The qualitative data gives more emphasis to the non-quantifiable responses. Selected due to its flexible nature.

The required data will be gathered through questionnaires but more emphasis will be given for interview and face to face discussion specifically with selected respondents.

Therefore, the qualitative method will be used to support the quantitative data that will be collected in the research. Finally, based on the obtained data and results of the analysis, conclusions and recommendations will provided.

6.2 Location of Study Area

Legedadi Deep wells water supply project is a water supply project from a source of 10 deep wells having an average depth of above 500m and estimated capacity of 40,000 m^3/d treated water is located in localities of;

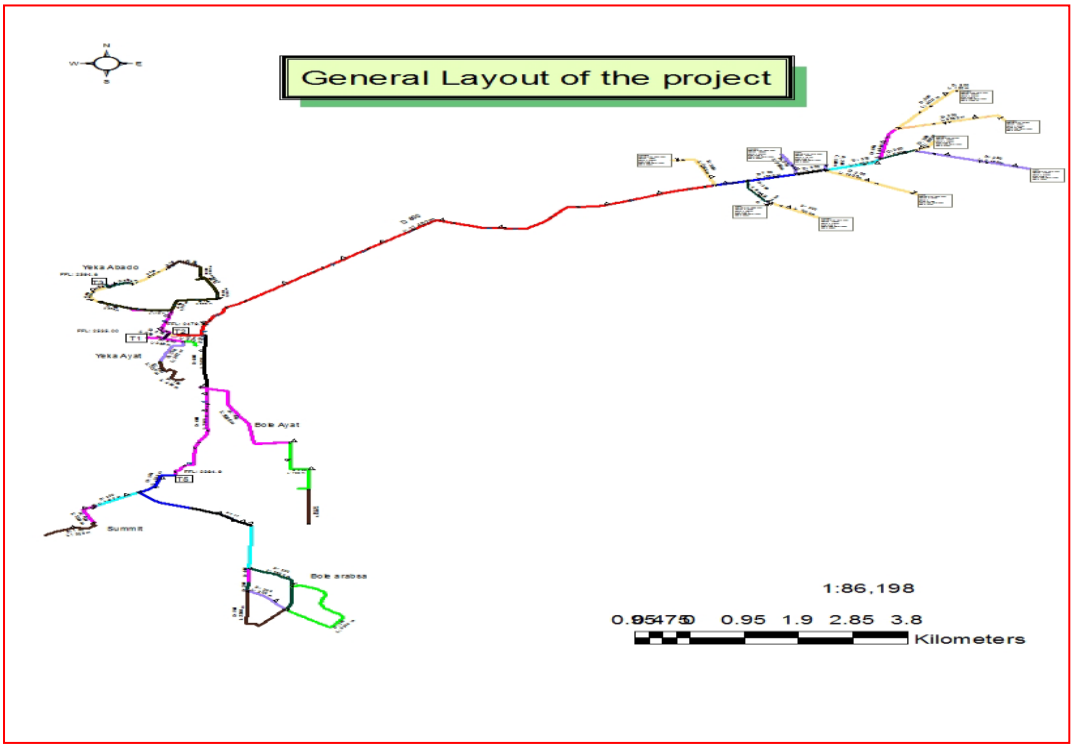
- LegeBeri,
- Lege Belo kebele and
- DabeMudakebeles in Legedadi area of Oromia special zone at a distance of

30km from Addis Ababa in North East direction along Desse road.

The project at the beginning has been designed to a total capacity of satisfying a daily demand of 333,333 inhabitants at a daily consumption rate of 120 l/c/head of 69,000 new condominium houses which is can reside about 276,000 inhabitants at 4 person per house.

Collector pipes installed in the well field in Oromia special zone, Main water conveyance system from well field up to Reservoirs and boosting station located in Bole & Gulele sub cities and water distribution system covers residential expansion areas of YekaAbado, Ayat, Summit and Bole Arabssa area.

Figure: 6.1-Map of the case study project



6.3 Specific Participants

The participants that will be included in this research will be selected based on the following primary requirements;

- Participants from the project owner must be professionals participated during design and construction stage of the project.
- Participants from the consultant must be professionals involved starting from design up to commissioning stage of the project.
- Participants must be registered GC or BC of Grade 1Contractors.
- Individual participants must be professional engineers/architects, procurement and Financial experts.

- All participants in this research will be highly experienced in project management and contract management in water related construction projects.

In general, the project owner 'Addis Ababa Water and Sewerage Authority' and the consultant 'Water Works Deign and supervision Enterprise' including civil and electromechanical contractors (French & Chinese firms) will be the main participants of this research.

6.4 Data Collection Methodology

The required data will be collected by using questionnaire. A questionnaire is developed in order to assess the perceptions of different parties involved specifically in Legedadi deep wells water supply design and construction projects and those participated in construction sector in general.

The methodology adopted for this research comprises the following three stages:

Stage 1.

Literature Review to determine the research focus. Local and International

Studies conducted particularly on related works and construction delays in general

Will be reviewed.

Stage 2.

Data collection, this stage consists of the following three activities;

Activity 1.

General survey of stakeholders (Owners, Contractors, Consultants and Subcontractors) to examine the cause and effect of delays in Legedadi Deep wells water supply design and construction project (phase I).

Activity 2.

Specific quaternaries survey of stakeholders and participants Professionals in the Design and construction of LDWWS Project (Owners, Contractors, Consultants and Subcontractors) to identify the Causes and effects of delay on the final expected result of the project.

Activity 3.

Desk work on project final signed documents prepared by the Consultant and approved by the client for construction which includes the following but not limited to;

- Detail Project Design Reports,
- Bill of Quantities,
- Contract agreement,
- Specifications etc.
- Interview with key professionals and Experts and
- Payment certificates and foreign procurement documents
- Final manuals such as Operational and maintenance manuals and provisional and final commissioning documents.

Stage 3.

Data analysis using scientific methods from raw data collection followed by sorting the data and under-takes analysis on specific issues related to the study topic causes and impacts of delay in the case of Legedadi Deep Wells Water supply Project Phase I) constructed for the city of Addis Ababa in Ethiopia.

Quantitative data analysis method (Likert scale) will be used to reach the final output of the research.

7. Expected Outcomes

Specific outcomes of this research proposal may not be possible at present but, in general the following outcomes are expected from the research;

- Identification of Major Causes of the project delay.
- Identification of Impacts caused by the time overrun or delay.
- Identification of amount of revenue which is supposed to be collected in the time of delay.
- Conclusion and recommendations will be presented.

8. Work Plan

The overall time to be allocated for the research work is pre-determined by the graduate program, which is one year to execute the following major tasks of the research paper;

- Data collection
- Data analysis and
- Research report writing.

Details activities break dawn of the research process are illustrated in the following bar chart in the next page;

Table 8.1 Activities work plan

No.	Activities	Units	Qt'y	Months (March - June/2018 G.C)															
				March				April				May				June			
				1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Research proposal submission & approval	Weeks	4																
2	Literatures review	Weeks	1																
3	Data collection	Weeks	3																
4	Data analysis	Weeks	1.30																
5	First Draft Submission	Weeks	1																
6	Corrected draft returning	Weeks	1.40																
7	Final signed draft submission	Weeks	1																
8	Defense Week	Weeks	0.7																
	Total work schedule span ➡	***Month***	***3***																

9. Budget/Logistics

The following material and financial requirements are set as a base to execute the research starting from the beginning up to its final submission date. As per indicated below about a total of ETB 10,560.00 is required including 10% contingency.

Table 9.1 Budget/Logistics requirement

No	Descriptions	Unit	Amount (Birr)	Remarks
1	***Materials***			
1.1	Photo Camera (Rental for 3 days)	LS	1,000.00	
1.2	Voice Recording Tape (rental 3 days)	,,	1,500.00	
1.3	Four Note pads	,,	160.00	
1.4	One Flash (8GB)	,,	300.00	
1.5	One Hut	,,	140.00	
2	***Literatures & project documents review***			
2.1	Photocopy	LS	400.00	
2.2	Printing	,,	500.00	
2.3	Internet	,,	800.00	
3	***Data collection***			
3.1	Transportation for Field work (5 trips)	LS	1,000.00	Birr 200/day
3.2	PD for 3 field work facilitators (3 days)	,,	3,000.00	Birr 200/d/head
4	***Data analysis & report writing***			
4.1	Two sets of draft report printing (black & white)	LS	500.00	
4.2	Final report Color production (Six Sets)	LS	3,000.00	
	Sub Total		***9,600.00***	
	Contingency (10%)		***960.00***	
	Grand Total		***10,560.00***	

REFERENCES

1. Hamed Samarghandi1, Seyed Mohammad Moosavi Tabatabaei2, Pouria Taabayan3, Ahmad Mir Hashemi4, 'Studying the Reasons for Delay and Cost Overrun in Construction Projects' (2016, Malaysia, v.*21(1), pp.51–84*:

2. WorkuKoshe, K.N.Jha 'Investigating Causes of Construction Delay in Ethiopian Construction Industries', (2016) DireDawa, Ethiopia.

3. Mohamed M. Marzouk ,Tarek I. El-Rasas 'Analyzing delay causes in Egyptian onstruction projects' (2012). v. pp.51-55, Egypt.

4. ZinabuTebejeZewdu 'Construction Projects Delay and Their Antidotes: The Case of Ethiopian Construction Sector (2016) Ethiopia.Vol. 5, 113-122

5. ShewaferahuTilahun, 'Cause and Effects of Delay on Educational Building Projects in Addis Ababa University' (2016) Addis Ababa, Ethiopia

6. PärKarlsson, 'Project Management in Sweden and Ethiopia', (2011) Sweden, pp.43-67

7. Dr. DavendraVerma, 'Study on project schedule and cost overrun (Infrastructure projects)', (2012) New Delhi, India. pp. 7-33

8. The Associated General Contractors of America, 'Guidelines for a Successful Construction Project' (2003) America. pp. 32-54

9. N. Hamzah, M.A. Khoiry, I. Arshad, N. M. Tawil and A. I. CheAni, 'Cause of Construction Delay Theoretical Framework', (2011) Malaysia. v. pp.491-494

10. Shabbab Al Hammadi1, M. SadiqueNawab,'Study of Delay Factors in Construction Projects', (2016) KSA, v. 3, pp.91-93

11. Nabil Al-Hazim, Zaydoun Abu Salem, Hesham Ahmad, 'Delay and Cost Overrun in Infrastructure Projects in Jordan', (2017) Jordan, v. pp. 18-24

12. United Nations Organization (UNOPS), 'Design Planning Manual for Buildings'. (2014), pp. 35-184

13. African Development Fund, Project Completion report of Harar Water Supply and Sanitation Project, (2013), pp-10

APPROVAL SHEET

ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

Submitted by:

ZelalemTsegayeAsmare	_____	March 2018
Name of Student	Signature	Date

Approved by:

1. Professor Belete Kebede	_____	_____
Name of Major Advisor	Signature	Date
2. _____	_____	_____
Name of Co-Advisor (if any)	Signature	Date
3. _____	_____	_____
Name of Chairperson, DGC[1]	Signature	Date
4. _____	_____	_____
Name of College Dean	Signature	Date
5. _____	_____	_____
Graduate Program	Signature	Date
6. _____	_____	_____
Name of Chairperson, CGP[2]	Signature	Date

[1]Departemental Graduate Council

[2]Council of Graduate Program

APPENDIX – B
QUESTIONNAIRE

1. QUESTIONAIRE;

1.1. Questionnaires for Data Collection.

Dear Respondents,My Name is ZelalemTsegayeAsmare, Graduating class student in Addis Ababa Science and Technology University (AASTU).

The main purpose of this questionnaire survey is to undertake a research on ***'Causes and Effects of Delay in Legedadi Deep Wells Water Supply Design and Construction Project (Phase I)***'in Addis Ababa as a partial fulfillment of the requirements for the award of ***MBA in Construction Management.***

The researchers assures you that your individual response will be kept confidential. Therefore, you are kindly requested to respond sincerely and honestly.

The questionnaires have been prepared in ***THREE*** sections;

- **Section A;**

  Consists of questions that aimed at collecting general information, profile and experience in construction industry of the respondents.

- **Section B;**

  Is aimed at finding out general factors affecting water supply study, design and construction projects

- **Section C;**

  Consists of specific questioners related to causes and effects of delay of Legedadi Deep Wells Water Supply study, Design & Construction Project (Phase I).

Hence, I request you kindly to fill up this questionnaire which will have significant help to my research. I assure you that, this study is entirely intended for academic purposes and confidentiality of your response is fully guaranteed.

Therefore, would you please go through the required data and give the correct and accurate possible answers?

Hope the required information will be provided by the respondents as timely as possible; since timely reply is very crucial for this research analysis.

Finally, thank you very much for your brand cooperation, kindly and timely respond to provide the required data.

Thank You

Section -A

General Information.

Please put tick mark ◯ indicate your response;

1. Name of the respondent (Optional) ……
2. Gender:

   Male ◯ Female ◯

3. Job Status

   Manager ◯ Team Leader ◯ Expert ◯ Others ◯

4. Relevant work experience

   Up to 5 years ◯ 5-10 Years ◯ 10-15 Years ◯ Above 15 years ◯

5. Educational qualification

   Diploma ◯ 1st Degree ◯ 2nd Degree ◯ PhD ◯

6. Profession

   Civil Engineer ◯
   Hydraulic Engineer ◯
   Structural Engineer ◯
   Water Supply Engineer ◯
   Business Administration ◯
   Others ◯

7. Type of Organization:

   Employer ◯ water works contractor ◯

   Consultant ◯ Supplier of Pipes & Fittings ◯

   Supplier of EM Equipment's ◯

8. Number of Employees working in your organizations:

   Permanent Employees: 500-1000 ◯ 1001-2000 ◯ above 2001 ◯

   Temporary & Contractual Employees: 50-100 ◯ 101-500 ◯ Above500 ◯

9. Organization Capital;

   50-100 Million ETB ◯ 501M-1Billion ETB ◯

   101-500 Million ETB ◯ More than 1 Billion ETB ◯

10. Number of water study, Design & construction Projects successfully completed in the last 5 years;

    10-20 ◯ 21-35 ◯ 36-45 ◯ Above 45 ◯

11. Number of Projects successfully completed as per the set time table:

    10-20 ◯ 21-35 ◯ 36-45 ◯ Above 45 ◯

12. Number of Projects delayed beyond project time table:

    5 ◯ 10 ◯ 15 ◯ 20 ◯ All projects ◯

13. Percentage of additional Cost variation due to delay;

    5-10% ◯ 11-20% ◯ 21-30% ◯ Above 30% ◯

14. Number of Projects Terminated by the project owner/Consultant due to delay;

    2 ◯ 4 ◯ 6 ◯ above 6 ◯

15. Major Causes of Project Termination;

    Excess cost variation due to design error ◯

    Low Contractor's construction capacity ◯

    Poor quality material supply from abroad ◯

    Financial problem from Employer side ◯

    Others…….. ◯

Section -B

General Factors affecting Water Supply Study, Design and construction projects

The following are in relation affecting performance of both study/design and construction of water supply projects.

Indicate the importance of the following factors as key performance indicators by ticking the appropriate box as per your observation, Experience and knowledge as per the following rating (Likert Scales);

1=Very low 2=Low 3=Average 4=High and 5=Very High.

1. ***Resources & Capabilities of your company/Organization.***

No	Factors	Rating				
		5	4	3	2	1
1	Financial Resource					
2	Technical competence					
3	Leadership					
4	Experience					
5	Incentive system					

2. ***Relationship strength with other parties & Capabilities of your company/Organization.***

No	Factors	Rating				
		5	4	3	2	1
1	With Clients					
2	With Consultant					
3	With Government					
4	With Contractor/supplier					
5	With Workers					

3. ***Total performance level considering its performance in relation to learning and growth of employees.***

No	Factors	Rating				
		5	4	3	2	1
1	Employees Training					
2	Employees satisfaction					
3	Employees motivation					
4	Employees turnover					
5	Employees retention					
6	Employees productivity					
7	Employees empowerment					
8	Employees experience					
9	Quality of work environment					
10	Leaders development					
11	Employees ethics					

4. ***Total performance level considering its employee learning and growth in relation to internal performance/process.***

No	Factors	Rating				
		5	4	3	2	1
1	On time delivery					
2	Quality of performance					
3	Timely decision					
4	Revenue growth					
5	Improvement in monitoring & Evaluation of projects					
6	Reduced cost & time overrun					
7	High customer satisfaction					
8	Company assets growth					
9	Internal relationship growth					
10	Team working growth					

Section - C

Specific Questioners related to causes and Effects of Delay of Legedadi Deep Wells Water Supply study, Design & Construction Project (Phase I).

The following questioners are related on Causes and effects of delay in Legedadi Deep Wells water supply study, design and construction project and please respond for the issues rose starting from study and design stage, Construction stage and Commissioning stages.

Indicate your level of agreement and disagreement by ticking the appropriate space provided in the table as per your observation, Experience and knowledge as per the following rating;

1=Very low 2=Low 3=Average 4=High and 5=Very High.

In addition rank the degree of severity of the problem in each phase of the project;

- Pre Construction stage/Study and design
- Construction Stage and
- Post Construction.

No	*Issues*	*5*	*4*	*3*	*2*	*1*	*Rank*
1	**Study and Design Stage**						
1.1	Sufficient time was given for study/Design						
1.2	Sufficient manpower was deployed						
1.3	Sufficient input data were used for S & design						
1.4	Wells have been all drilled and their yield were known						
1.5	Sufficient field investigation was performed.						
1.6	All required data from the client were provided						
1.7	All the required design data were available						
1.8	All design reports prepared as required						
1.9	All Tender docs were prepared as required						
1.10	All Specifications are prepared perfectly						

1.11	All BOQ documents were prepared correctly.						
1.12	Client has given his comment on all project documents at draft, final draft and final reports.						
1.13	Client has given sufficient assistance during study & design						
2	**Construction Stage**						
2.1	Poor contract management						
2.2	Complexity of site Investigation						
2.3	Shortage of qualified & sufficient manpower						
2.4	Delay in design approval by the consultant						
2.5	Client initiated changes/Additional						
2.6	Delay in Payment approval by the Consultant						
2.7	Delay in Payment to the contractor by the client						
2.8	Design errors and revisions						
2.9	Poor site management & Construction supervision						
2.10	Client's excessive pressure to complete the design						
2.11	Clients high Ambition to get and supply additional water						
2.12	Clients weak follow of design & construction works.						
2.13	Delay in testing construction material samples.						
2.14	Delay due to Right of way problem.						
2.15	Delay in getting approval from plan commission.						
2.16	Delay due to insufficient cooperation of EEU						
2.17	Delay due to insufficient help of stakeholders						
2.18	Poor engineering estimate preparation (BoQ)						
2.19	Bad weather condition						
2.20	Lack of timely decision by the consultant						
2.21	Lack of timely decision by the Client						
2.22	Frequent rework						
2.23	Delay in site mobilization						
2.24	Poor schedule management						
2.25	Mistakes and inconsistency in design document						

2.26	Change in Material specifications						
2.27	Poor Contractor's capacity						
2.28	Nature of inter personal relations in the project.						
2.29	Late delivery of Material supply from Abroad						
2.30	Slow redesigning process						
2.31	Residents at well field are not benefited from the project						
3	**After Construction**						
3.1	Excess pipes and fittings are observed						
3.2	High effect on the client's revenue collection plan due to delay						
3.3	Customers grievances were high due to late service delivery						
3.4	Positive Image of the project owner were faded						
3.5	There are Quality problems of the constructed project						
3.6	There is operation & maintenance problem by the client						
3.7	Maintaining operational sustainability may not be possible.						
3.8	Problems are occurring due to unaddressed social issues						

At the end I would like to thank you once again and remind you to list out in the following space if you have any other issues which are not covered in this questioner.

a) ……
……
……

b) ……
……
……..

c) ……
……
……

d) ……
……
……..

- My address: yalem_kal@yahoo.com or zelalemtsegaye64@gmail.com
  And mobile telephone; 0920-771121 or 0911-442613

APPROVAL SHEET

ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

Submitted by:

ZelalemTsegaye Asmare	_____	04 April 2018
Name of Student	Signature	Date

Approved by:

7. Professor Belete Kebede	_____	_____
Name of Major Advisor	Signature	Date
8. _____	_____	_____
Name of Co-Advisor (if any)	Signature	Date
9. _____	_____	_____
Name of Chairperson, DGC[1]	Signature	Date
10. _____	_____	_____
Name of College Dean	Signature	Date
11. _____	_____	_____
Graduate Program	Signature	Date
12. _____	_____	_____
Name of Chairperson, CGP[2]	Signature	Date

[1]Departemental Graduate Council

[2]Council of Graduate Program